THE

ELECTRICAL REVIEW.

VOL. LVI. MAY 26, 1905. No. 1,435.

ELECTRICAL REVIEW.

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THE

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LONDON ELECTRIC POWER SUPPLY.

THE announcement of the decision of Lord Camperdown's Select Committee on the fate of the Bills, upon which the Committee has been hearing evidence during the past two months, will be read with interest. In our last issue we stated that the City of London and the Charing Cross Companies' Bills were not to proceed, while all the others were allowed to go forward to the consideration of clauses, subject to certain specified limitations.

Chief interest, however, centres on the Bills introduced by the Administrative County of London and District Electric Power Supply Co. and the Metropolitan Electric Supply Co., which were held over for further consideration, with a view to safeguarding the interests of the companies whose systems were subject to the compulsory purchase clause. On Monday the Committee's decision with regard to these Bills was announced, and it is detailed elsewhere in this issue.

It appears that the difficulty above mentioned has been met by inserting clauses in the Bills which shall afford protection to the authorised distributors with whom competition will be set up, and shall endue the Board of Trade with very wide discretionary powers of control. Apart from this question, the Committee has decided to allot to the Administrative Co. the eastern industrial area, whilst dividing the western (non-industrial) areas between the two companies, the Metropolitan Co. on the north and the Administrative Co. on the south of the river.

It will be obvious that, so far as motive power supply is concerned, these two companies will be in direct competition with almost the whole of the London electricity supply undertakings. We have often urged that the real future of electricity supply is bound up with the development of electric motive power, and on this basis it is clear that the position of the authorised undertakers, especially in the eastern areas, may be seriously affected. We are not prepared, however, to say that the general public will be the losers thereby. It is true that some of the existing municipal generating stations are very well managed, and are not a burden on the rates, but on the other hand, there are certain stations whose doleful record is only equalled by their dismal prospects. Who, for example, will deny that it would be to the public benefit for the Southwark Electricity Works to be converted into a sub-station, distributing energy at a price less than half the present cost of production? It may be that the Administrative Co. has cut its estimate of outlay too fine, and has overrated the prospect of an 8 per cent. dividend, with a selling price of 0·75d. per unit; but the importance of cheap motive power cannot be exaggerated, and we would say—let the companies try their hand; at any rate, the loss, if loss there be, will not fall on the ratepayers.

D

The B. of T. Tramway Regulations.

We alluded recently to a rumour about a new B. of T. regulation asking for fortnightly tests of trolley wire insulators, and added that we thought that the B. of T. had carried its provision for safety a little too far. Further inquiry has shown that while we were quite justified in alluding to this as a rumour, we were equally justified in making a somewhat guarded statement about it. As most of our readers are aware, there are two kinds of B. of T. tramway regulations; one known as "Protective," with a ridiculously long official title, and the other, made after each tramway has been opened, called "Working." The "Protective" deal with prevention of electrolysis, and the "Working" with speeds, details of construction, and other matters connected with the safety of the public. The "Protective" regulations have always asked for a *daily* test "before or after the hours of running, when the line is fully charged." The result (laid down, be it remembered, in March, 1894) should be that the leak, if any, should not exceed 1-100th of an ampere per mile of tramway, and "if at any time it should be found that the leakage current exceeds one-half of an ampere per mile of tramway, the leak shall be localised and removed as soon as practicable, and the running of the cars shall be stopped unless the leak is localised and removed within 24 hours." This regulation was made in the interests of owners of gas and water pipes, and of telephones and telegraphs, more than 11 years ago. It never had anything to do with the safety of the public. It is well known to tramway men that such leakages as those suggested in this regulation are seldom if ever found. The leak is either a mere trifle, or it is a serious one, needing no test, but declaring itself, long before the time for shutting down, by opening the circuit-breaker. The regulation was therefore almost superfluous; nobody, for a long time, was inconvenienced, and nobody cared whether "per mile of tramway" meant mile of track or mile of route, or knew what was to be done in the case of an all-night service.

But in some large tramway systems, where there are distant car-sheds, lighted from the trolley wires, and where cleaners are busy "after the hours of running," this regulation has been found troublesome: for a single series of lamps left on, by accident, would show up as a bad leak. It appears that requests have been made from such places for relief from the daily test, and the result has been, if we are correctly informed, that the daily test has been abolished in all recent issues of the "Protective" regulations, and a *weekly* test has been substituted. But this is not all. It seems that in one case, if not in others, the request for relief from the daily, or as we should prefer to call it, the nightly test, was accompanied by the argument that there was no intention of being careless about insulation tests, for a fortnightly test of each insulator was the ordinary practice. Now it is probable that, owing to rather serious accidents, live poles, horses killed, and one case of a fatal accident to a lineman through the failure of a hanger insulator making a span wire "live," the B. of T. had turned over some further regulation in its mind. The Board seems to have jumped at this suggestion, and changed "daily" into "weekly" in the Protective regulations, whilst adding to the "Working" regulations one which asked nothing more than what had been done for years at this particular town. But it is not surprising that other towns, either not so particular about testing, or possessing equipment which in their opinion did not want such careful nursing, grumbled rather loudly at the fortnightly regulation, and not without effect, for it seems that, after making some inquiries, the B. of T. has decided, for the present, that a 100 per cent. margin may be allowed, and the periodical test of insulators is to be "not less frequently than once in a month." We say "for the present," for these regulations are much more easily altered as circumstances require than the electric lighting regulations. As a matter of fact, the new regulation does not go so far as we admitted might be reasonable, for the monthly test applies to the whole tramway system in each case, and busy parts are not to be tested more frequently, unless, indeed, the engineers think it wise to do so.

The Powers of a Tramway Company.

A case which raised a point of considerable importance to electric tramway companies was decided by Mr. Justice Warrington on May 20th. The question under discussion was whether certain general words in a tramway company's private Act were sufficiently wide to enable the company to lay cables under certain streets, &c., for the purpose of taking a supply of electricity from the generating station of an independent company. The facts of the case are set forth on another page of this issue. The only dispute in the case was as to the meaning of Sec. 27 of the London United Tramways Act, 1901. The material parts of this section are as follows:—

> **The company may execute all such works on or in connection with the tramways, and in, over, or under the streets, roads or bridges in or over which the same are laid as may be necessary or expedient for working the tramways by mechanical power as aforesaid, and may lay down, construct, erect and maintain on, in, under or over the surface or bed of any street, road, footway, bridge, river, or place, and may, with the consent in writing of the owner and occupier of any house or building, attach to such house or building such posts, conductors, wires, tubes, mains, plates, cables, boxes and apparatus, and may make and maintain such openings and ways in, on, or under any such surface or bed as may be necessary or convenient either for the working of the tramways or for providing access to or forming connections with any generating station or other stations, engines, machinery or apparatus.**

The London United Tramways Act, 1902, authorised certain extensions of the defendant company's lines in (amongst other places) Wimbledon, Merton and Kingston, and it incorporated the provisions of the Act of 1901, including (*inter alia*) the section above set out. It was contended on the part of the Wandsworth Borough Council that the words "any generating station" which appeared in the section must mean any generating station belonging to the company, or "any generating station authorised by this Act." The company, on the other hand, argued that there was nothing in the rest of the Act to support this contention, and that it was clearly the intention of Parliament to allow the company to connect up with any generating station.

Mr. Justice Warrington's decision appears to us to be a logical consequence of the words used in the Act of Parliament. If, as we believe, the learned judge's interpretation of the language is correct, the tramway company might obtain their supply, not only from Lot's Road, Chelsea, but from any other generating station in the country which was willing to come to terms. The interpretation put upon this section is also important in view of the wording of a clause of a model form of Light Railway Order. That clause provides that—

> **Subject to the provisions of this order the company may erect, lay down and maintain on, in, under, or over, any road or the footpath of any road such posts, conductors, wires, tubes, mains, &c., as may be necessary or convenient either for the working of the railway or for forming connections with any generating station, and the powers and obligations of the company under this order with respect to the opening or breaking up of any road shall so far as they are applicable apply with respect to such footpaths. Provided that the powers of this section shall not be exercised with respect to any road or footpath except with the consent (which shall not be unreasonably withheld) of the road authority, and if any difference arises as to whether such consent is unreasonably withheld, that difference shall be referred to arbitration under this order.**

Having regard to the provisions of this section, it appears to us that in the light of Mr. Justice Warrington's decision, it would be competent for any light railway company working in accordance with its provisions to lay mains to any generating station, whether it is their own or not. It is interesting to speculate whether the Wandsworth Borough Council ever imagined that they were going to be affected by the London United Tramways Bill of 1901. We can well

imagine that the learned counsel who drafted the clause in question, is having a laugh in his sleeve at the effect of his draftsmanship, the result of which has been to confer upon the London United Tramways Co. a privilege of which they can only be deprived by another Act of Parliament.

Allowance for Depreciation in Private Plants.

In giving evidence before the Committee of the House of Lords appointed to consider the power schemes for London, Mr. Bailey in the course of his evidence brought into relief a point which has too often been neglected when comparing the cost of power produced by small private plants and that obtained from a central station. In the latter case the cost per unit includes a certain proportion set aside to meet the interest on capital expended, and to provide for depreciation of plant. In the former case depreciation is often entirely neglected by the owner when comparing his running costs with the expense of supply from a supply authority; and where it is allowed for, it is generally based on an approximate estimate of the life of all the "plant and machinery" in the works. Needless to say, such an allowance is crude in the extreme, and would in many cases be productive of actual deficit if the plant had to be renewed out of the savings effected by abjuring the public supply. Judging by the antiquated apparatus still seen in many mills and factories, some of the machinery has a life equal to that of the average human being; and even if the electrical gear can be patched up into a species of second childhood, the central station will in the meantime have utilised its depreciation fund to buy new and improved apparatus tending to bring down its cost per unit.

Moreover, we would point out that the type of plant usually installed and the kind of treatment usually bestowed in a private installation tend to make the rate of depreciation, even for steam and electrical plant, higher than it would be in large machinery properly tended. For example, a storage battery is often an adjunct to such an installation, an apparatus which, in a greater degree than perhaps any other plant in a central station, requires the careful attendance of skilled men to enable it to last its allotted 10 years' span in the depreciation scheme. Yet it is left to the tender mercies of the greaser-switchboard-attendant, or the man that curry-combs the mare.

The type of engine favoured in small installations is of either the gas or the high-speed enclosed steam type. Either of these will run for a long time without skilled supervision, and are often made to do so. As, however, the progress of depreciation, due to wear in running machinery, increases at a greater rate than the time elapsing between the commencement of trouble and its rectification, it follows that such small plants will, with ordinary unskilled treatment, wear out much more quickly than plant fulfilling the same functions in a central station where skilled attendance in each department is possible.

It is evident, therefore, that when a comparison is instituted between the cost of power derived from a central station and from a private plant, a totally false estimate is arrived at by comparing only the running costs; allowance for depreciation must be added to the latter value, and such allowance should be a larger percentage of the initial value of the plant than in the case of the central station, to allow for increased wear and tear due to the type of plant and attendant employed.

Radioactivity and Snake Poisons.—Some time ago C. Phisalix announced that radium emanation acted upon viper poison in such a fashion as to cause it to lose its toxic and immunising properties. In a recent communication to the Académie des Sciences, he stated that the same thing applies to other snake poisons, such as that of the cobra, but it is not true of the "venom of the salamander" or that "of the common toad."

THE WILLANS-PARSONS STEAM TURBINE.

It is now more than two years since Messrs. Willans and Robinson, Ltd., decided to take up the manufacture of steam turbines. After a careful survey of the work being done in the direction of building turbines of different types, not only in this country, but also on the Continent and in America, negotiations were entered into with Messrs. C. A. Parsons and Co., and a licence to manufacture under their patents was taken. Consequently the Willans-Parsons turbine is identical in principle and in its main features with the Parsons standard type, and it is only in details of design and manufacture that there are differences.

Special attention has been given to the arrangement of the necessary details, such as the governor gear, oil pump, steam and water piping, &c., as it has been found that ability to inspect the working portion of a turbine without dismantling any attendant gear is a convenience appreciated by those who have to take charge of the running and maintenance of machinery. To enable this to be attained, all the gearing and fittings named above are mounted on the bottom half of the bearing pedestals, and the top cover of the turbine, as well as the bearing caps of the three main bearings, is left free for instant removal.

Fig. 1.—Half-Rings of Blades.

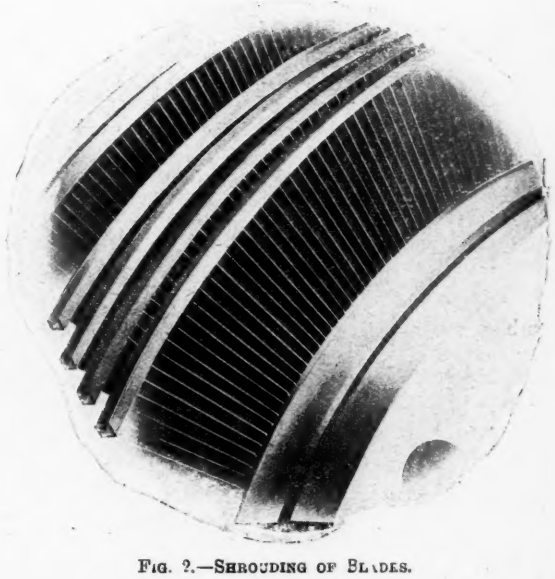

Fig. 2.—Shrouding of Blades.

Further to facilitate opening the turbine, the top half of the casing has been provided with two hinges, thus avoiding the use of guide studs and at once placing the turbine cover in a suitable position for examination.

In the case of the 1,000-KW. Willans-Parsons turbine, it is possible for two men to remove the main bearing caps and to open up the turbine for inspection in less than an hour. A view of a turbine opened up in this manner is given below.

By a re-arrangement of the balancing passages, it has been found possible to reduce somewhat the length of the ordinary parallel flow turbine, and further, thanks to Fullager's patent system of balancing, it has been made feasible to dispense with the large balance piston at the high pressure end of the turbine, and to substitute in its place one of considerably smaller dimensions at the low pressure end. It has been found in practice that this method of arranging the balancing pistons has the advantage of enabling castings of a more symmetrical form to be adopted, and in this way many of the troubles brought about by unequal expansion of the different parts are avoided.

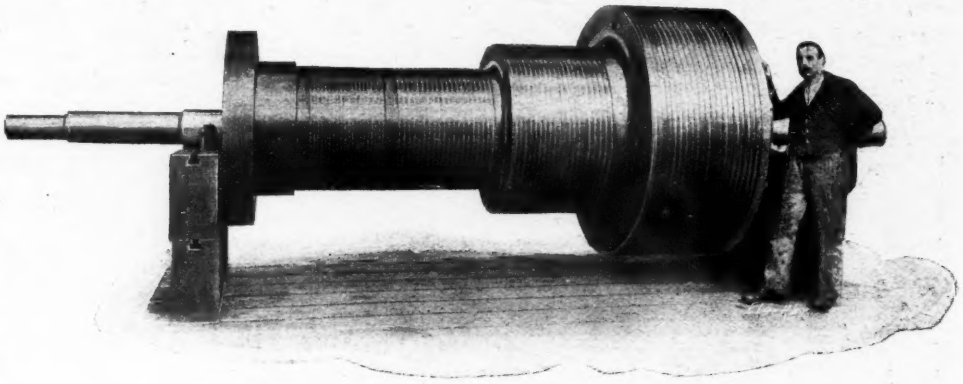

FIG 3.—ROTOR OF 5,000-KW TURBINE; SHAFT BEFORE BLADING.

An improved method of attaching the blades to the rotor and casing has been adopted in the Willans-Parsons turbine, by which great stiffness and rigidity are given to the blade rings when they have been fitted into their respective body or shaft grooves. In the ordinary turbine of this type, each blade is fixed separately into the rotor and casing by means of its own caulking piece. In the Willans-Parsons steam turbine, as will be seen from fig. 1 (p. 835), the blades for one complete ring are built up on two half rings, which have had the necessary grooves for receiving the blades cut in them by means of automatic machinery. These complete half rings of blades are then caulked into the shaft or the casing. Attention may be drawn to the fact that the cutting and assembling of the blading by means of specially designed automatic machinery ensures that the whole of the blade angles and openings, on which the efficiency depends, are absolutely mathematically correct.

Fig. 1 shows two of these half rings completed for assembling on the shaft and in the casing, and fig. 3 shows the shaft of a 5,000-KW. turbine ready for blading.

Another feature of the Willans-Parsons turbine consists in the special channel shrouding encircling the blades, which Messrs. Willans & Robinson have the right to use under the patent of Mr. H. F. Fullager. This shrouding is fixed on the half ring of blades before assembly on the shaft, or in the casing, and has several points of merit. It adds materially to the mechanical strength of the blades themselves, and removes any danger of the blades stripping should the rotor come into contact with the casing, or the blading on the casing come into contact with the revolving shaft. Further, the action of the channel shrouding when under working conditions, minimises the loss due to leakage over the revolving or fixed rows of blades, and by this means a considerable gain in the steam economy is effected. A view of the shrouding round the blades is shown in fig. 2 (p. 835).

Special attention has been paid to the question of governor gear, with a view of making it as simple and as reliable as possible. By dispensing with some of the intermediate gears hitherto used on governors controlling steam turbines, it has been found possible to eliminate many of the undesirable features, and to obtain results in the direction of close governing which, it is claimed, surpass anything hitherto obtainable.

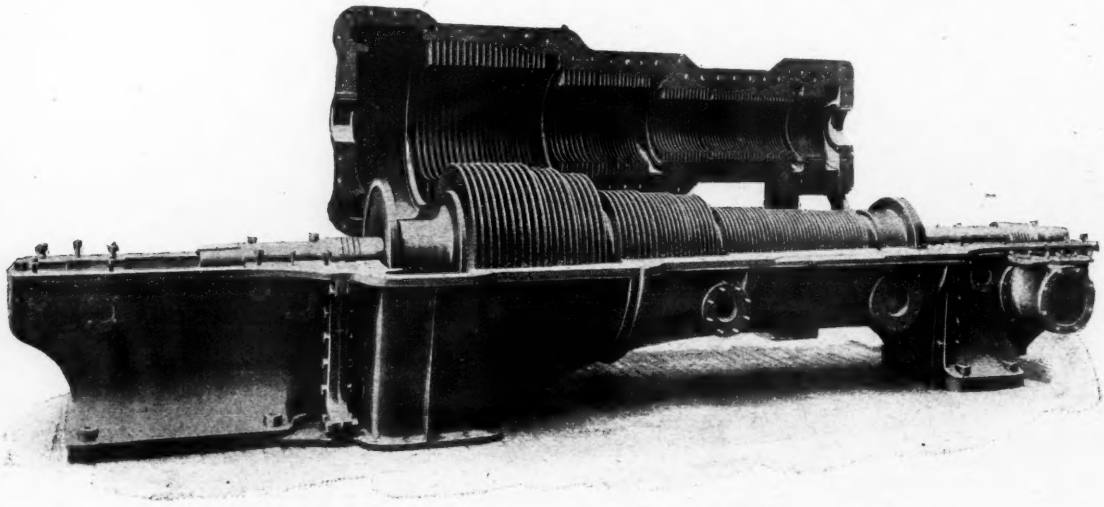

FIG. 4.—WILLANS-PARSONS TURBINE, SHOWING HINGED TOP RAISED.

All the turbines are fitted with by-pass valves which automatically open when the maximum economical output of the turbine is exceeded, and by means of these valves any required overload can be obtained up to the full capacity of the electrical generator, the steam economy of the turbine being, of course, reduced.

At the present time Messrs. Willans & Robinson have 24,250 KW. of this type of turbine at work or nearing completion, the smallest being of 750-KW. normal capacity, and the largest of 3,000-KW. normal capacity. Amongst others may be mentioned the following:—Two 3,000-KW. sets for the Glasgow Corporation, and a similar set for the Metropolitan E.S. Co., London, besides several of 1,000—1,500 KW. capacity.

Messrs. Willans & Robinson are to be congratulated upon the ready adaptiveness with which they have turned their hands to this new occupation, and having in mind the

honourable record which they have built up in the past by their excellent workmanship and engineering skill, we cannot doubt that their steam turbines will prove as satisfactory as the engines which have been so long associated with their name.

CORRESPONDENCE.

Letters received after first post on Wednesday morning cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Lambton Collieries Specification.

We are very glad to see that you are publishing an article on the above specification. In all our experience of electrical specifications for colliery work, we have never come across such a misleading, obscure and contradictory statement of requirements as this is. It appears as if it were drawn up by a German professor, who, with his head full of mathematical expressions, was writing a specification at the bidding of a German manufacturing firm. The specification is obviously written to favour Continental apparatus from beginning to end.

In colliery work the mechanical construction of the haulage gears, pumps and compressors is at least as important as the construction of the resistances of the controllers, about which several paragraphs of the specification are taken up. These mechanical considerations are entirely absent from the specification. We heard of a case of application being made to obtain information as to the construction of the gears required. The answer was that these gears were to *follow ordinary colliery practice* as regards their construction.

As regards the inaccuracies and contradictions in the specification, these you have brought out very clearly in your article. We may mention that we never before, in a specification for colliery work or any other work, heard of motor pulley wheels being made with a "momentum of inertia," in order to get over cyclic irregularity in the running of the compressors. The overloads asked for on the motors are certainly excessive, and we entirely agree with the last paragraph in your first article, in which you say that experience with three-phase haulage is not favourable to the practice of regulating the motors by the controllers. This has been abandoned in favour of the use of clutches for throwing the load off and on. We are aware of a considerable number of electrically-driven haulage gears working every day, using friction clutches for throwing the load off and on. One rather ridiculous thing you do not seem to notice is that drawings have to be provided for these special large haulage controllers, and not only drawings but *samples* have to be sent in with the tender.

As regards the mathematical formulæ which appear in two or three places in the specification, no clue is given as to what the symbols mean. One has to guess whether "T" stands for "time," "tide," or "torque," and it is the same with the other symbols. With regard to the penalties on the efficiencies of the motors, as the motors are regulated by resistances in the rotor according to the specification, there seems to be no need to put this enormous penalty on a difference of 1 per cent. or 2 per cent. efficiency at full load.

We are exceedingly glad to see a responsible electrical paper taking this matter up as you have done, as although parts of the specification are almost comical, the value of the work involved is very considerable.

It seems to us a shame that the value of this work should be lost to English workmen, and that a big English colliery company should allow themselves to be persuaded by German firms that such apparatus is better obtained abroad than at home.

Mining Engineers.

I am in receipt this morning of two copies of the ELECTRICAL REVIEW containing two articles in reference to the specification issued by the Lambton Collieries. I may say that this is a private issue, and we are surprised that a journal of the position of the REVIEW should lend itself to any such attack. We think we understand our business as well as the gentleman who writes your articles. We have had ample tenders from the very best engineering firms, who have accepted the specification without comment. The animus contained in the articles leads us to think they must have emanated from some disappointed engineer, who thinks the conditions too stringent and the penalties too heavy.

James Joicey,
Chairman of Lambton Collieries, Ltd.

London, *May 23rd.*

[We have pleasure in publishing Sir James Joicey's letter, but regret that he so utterly fails to realise the true position. We have no doubt that the Lambton Collieries, Ltd., understand *their* business as well as the writer of the article in question understands *his* business; but we are unable to agree that *they* understand *his* business—if they had done so, they would never have permitted that amazing specification to go forth in their name. We may assure our correspondent that when we criticised the specification, we knew *our* business too. We claim the right to exercise such criticism, and we must add that our critique was absolutely free from any personal bias or animus whatever—nor was it influenced in the slightest degree by any manufacturer, contractor, or "disappointed engineer." Our technical readers, we know, will endorse every word of the article.—EDS. ELEC. REV.]

Fault in a Shunt Dynamo.

I have a small dynamo to repair, a ring machine, shunt wound, Swiss make. I found two obvious faults—a partial earth on the rocker and dead earth on the commutator. I put these right, and, breaking the ring winding in two places, tested and found the winding was continuous. I find the machine runs well and sparklessly as a series motor, but can get nothing out of it as a dynamo, even when the field is separately excited.

The brush holders are fixed, and carbon brushes, making good contact, are used.

I should be greatly obliged if you could indicate where the fault is likely to be.

W.

Cost of Rubber Tires.

Having had the greatest experience in tyres for motor-omnibuses, we would like to point out that the estimate of 3d. per car-mile is more than 50 per cent. excessive; in fact, it may interest your readers to know that we guarantee the cost of Royal Sirdar-Buffer tyres never to exceed 2d. per car, mile, and that it invariably works out at less, and we have accepted large contracts at this maximum guarantee from the leading omnibus companies, Corporations, County Councils, who are running 'buses in Great Britain, including some of the principal railway companies.

Such statements as have been made in your paper in comparing the cost of maintenance of electrical trams with that of motor-omnibuses in relation to tyres (for tyres are given as the highest cost in maintenance) are likely to do a great deal of harm to the industry.

The Sirdar Rubber Co., Ltd.
J. M. MACLULICH.

London, W., *May 18th*, 1905.

Boiler House Records.

The remarks in your last issue upon systematic and intelligent records of boiler house working in power stations should appeal very strongly to all engineers entrusted with the efficient working of the same, although it is feared that not many would welcome the innovation in the precise form suggested.

It may be within the actual knowledge of your correspondent that such things have been done since the commencement "in real live earnest" at this power station, with some exceptions and additions, and it is no exaggeration to say that the records employed sharpen the wits of the whole staff, and add an interest in securing economy.

The system of mechanically "weighing in" the coal to each working boiler hopper possesses an immense advantage, if daily records are meted out the value they certainly

possess; many engineers shake their heads in doubt as to the benefit, partly on the score of capital outlay, but chiefly perhaps with sceptical views or of drastic alterations to the boiler house architecture to accommodate the same.

While it is true that the analysis of the coal should be known at stated intervals, it would be going too far to embody tests daily in the reports.

Calorimeter tests made "at home" are of little value, and very often misleading unless carried out by *one and the same man*, whose sole duty it is to work on matters chemical; such a man is seldom employed, and surely it is better to have tests made periodically by an independent chemist.

It is seldom practicable to weigh the ashes daily, since they contain a considerable amount of moisture from damping before being shot, and a variable allowance creeps into calculations. "The cubic feet of water pumped *to* the hotwell," &c., should probably read "from the hotwell"—why not insert one or more meters in feed range?

The addition of an apparatus to measure the percentage of CO_2 in the boiler gases is a direct advantage in ascertaining the efficiency of the boiler, stoker and brickwork. Uncovered bars, air leaks and varying draught are frequent sources of ineconomy, and by this means are quickly ascertained—most stokers have a firm belief in their own peculiar way of stoking, and will not be convinced of their error, if such there be, unless it is proved to them in black (or red) and white.

H. H. Perry.

Power House, Brimsdown.
May 22nd, 1905.

A "Light" Porter!

This is extracted from the *Daily Telegraph* of to-day. What are we coming to?

"Porter and Electrician seeks situation. Tall and smart."

Comment would be superfluous.

F. R.

Power Station Economies.

The following appeared in the *Daily Mail* for the 15th inst.:—

ELECTRICAL WASTE.

Some interesting comparisons in the cost of electricity for power purposes were given by Mr. J. A. Jeckell, electrical engineer to the city of Coventry, in a paper read to the Birmingham and District Electric Club on Saturday.

In 1900 the station costs at Coventry were 3·43d. per unit, whereas in 1905 these were only ·85d. On the other hand, the gross profit increased from 1·44 per cent. to 6·47 per cent., while the price to the consumer fell from 4·27d. per unit to 2·28d.

Were the Coventry system of economies adopted elsewhere, the same results would be possible, said Mr. Jeckell, who gave the following figures:—

	Price per unit.	Waste as compared with Coventry.
Coventry	0·85d.	—
Manchester	1·07d.	£26,552
Metropolitan area	2·45d.	£90,346
City of London	1·66d.	£49,971
Westminster	1·86d.	£55,072

The figures regarding wastage are based on the total output of electricity.

There is no doubt that the Coventry works are being run economically, but at the same time there are others doing equally well, For instance, Dudley, a neighbouring station, turns out 1,500,000 units at a total cost of ·84d. per unit. At Coventry the principal part of the output is used in driving motors in factories, while at Dudley trams are run from the municipal electricity works, so that these two works may be said to supply under approximately similar conditions.

To compare the City of London Co., the Metropolitan and Westminster areas where coal is expensive, and the demand purely a lighting one with Coventry, where the works are situated practically at the mouth of the coal pits, and the demand is chiefly utilised for power purposes, is utterly absurd.

It would be interesting to know what "the Coventry system of economies" consists of, and how these economies differ from those practised in other station. Surely others besides the author of the paper referred to know how to run a station—even if the author himself does not think so.

Lastly, it is not in good taste for any municipal official to "blow his trumpet" to the above extent, particularly when he finds it necessary to criticise the work of others while ignorant of the local conditions governing them, finally referring to the results as showing "waste" as compared with his own work.

Station Engineer.

New Regulations for Electricity in Mines.

In your issue of 12th inst., the firm of Everett, Edgcumbe & Co. thought fit to wantonly attack us in an impertinent letter which they addressed to you, professing to have discovered the means of accurately carrying out the testing of electrical installations in mines under the new Home Office regulations, having regard, of course, to the difficulties alluded to in Mr. Harris's letter of the 7th inst., published in the REVIEW. They gratuitously offered to furnish us with particulars of this apparatus, which accordingly we wrote for; after several days' delay we received price lists but no details, which under the circumstances we had a right to expect, and from the absence of these it might be inferred that their apparatus would be equally inaccurate under certain conditions alluded to in Mr. Harris's letter.

In conclusion, we must decline to carry this correspondence further as far as Messrs. Everett, Edgcumbe & Co. are concerned. We have answered a letter addressed to us through your columns, practically under compulsion, and do not wish to emulate the bad taste displayed by Messrs. Everett, Edgcumbe & Co. in attacking us under the guise of replying to a letter, which Mr. Harris wrote in his private capacity in order to avoid using your "Correspondence" columns as an advertising medium.

Nalder Bros. & Thompson, Ltd.,
FRAS. H. NALDER, *Managing Director.*

London, E.C.,
May 19th, 1905.

CHARGING FOR ELECTRICITY.—"Inquirer" asks whether consumers who have several shops fitted up for electric lighting are allowed discount as one consumer, or whether each of the shops is considered separately. He mentions the case of a consumer who has three shops, and who, if charged on one bill only, would have several pounds more allowed in discount than when charged for each shop separately.

A correspondent asks for the name of the makers of "Graham's loud speaking Navy telephones."

LEGAL.

CORPORATION OF BIRMINGHAM *v.* BIRMINGHAM CANAL NAVIGATION CO.

IN the Chancery Division of the High Court of Justice on Thursday, May 18th, Mr. Justice Farwell had before him an action by which the Corporation of Birmingham claimed a declaration that they were entitled under provisions of Sec. 82 of an Act of William the Fourth of 1834, and under the conditions of a later Act of Queen Victoria, to take water from the Birmingham and Fazeley Canal for the purpose of condensing water for their steam engines employed in generating electricity for lighting purposes.

Mr. Upjohn, K.C., and Mr. R. J. Parker appeared for the plaintiffs, and Mr. Cripps, K.C., and Mr. Sargant appeared for the defendants.

Mr. PARKER, in opening the case, said that it would really depend on whether within the meaning of certain statutes an electrical generating station for the generation of electrical energy was a manufactory under an Act of William the Fourth.

His LORDSHIP: That would be some time before the generation of electricity was well known.

Mr. PARKER said that was one of the questions which arose in the case. There was, further, the question of whether the words of the Act were sufficient to extend to manufactures invented after the Act was passed. Electricity was well known before then, but

it was not generated in large quantities. The Corporation were the owners of a piece of land in Summer Lane, Birmingham, and they had given defendants notice in writing of their desire of obtaining from the canal a supply of water for the engines in their generating station. The defendants refused to allow the Corporation to make such connection for the purpose, under the Act of George the Third, which provided that water could be taken from the canal by adjoining owners for condensing the steam of steam engines employed in the manufactures of Birmingham and in corn mills. Counsel proceeding, said that by the Act of William the Fourth, it was made lawful for all persons and corporations who then possessed any steam engines situated within 200 yards of the canal, and used for the purposes of any manufactures, or for any corn mills, ironworks, collieries or other works then existing or thereafter to be established, to make communication between the water of the canals and the engines, and to draw from the canals such quantities of water as should be sufficient to supply such engines for carrying on the manufactures. The learned counsel submitted that the Acts clearly provided for the water of the canal being used for the engines of manufactories other than those existing at the time the Acts were passed. A generating station, he submitted, came within the meaning of a manufactory. It was impossible for him to describe what electricity really was, but it certainly was a marketable commodity. It was very often defined as a current, and also as a fluid. Text-books which had been superseded by newer ideas said it was a form of motion.

His Lordship: I shall want an expert adviser, if I am to say what electricity is.

Mr. Parker, proceeding, said that, whatever it was, it certainly fulfilled all the conditions of a marketable article. It could be produced, it could be sold, it could be measured, it could be stored, it could be carried about from place to place in bulk, it could be stolen, and it could be felt. However it might be defined, it had all the characteristics which were necessary for constituting a vendorable article. It was for the production of this article on a large scale that the generating station had been erected, and he submitted that it made the generating station with its buildings and appropriate machinery a factory, just as the laying down of large plants for producing wool, would make that building a factory within the meaning of the Acts in question The raw material in all these generating stations was the coal. By the aid of the coal they obtained the heat to develop steam, and by the aid of the steam they turned the dynamos which produced the current which was stored and sold. It was said that this was an unknown process at the time the Act of George the Fourth was passed. It was unknown how to produce electricity on a large scale, but electricity itself had been known for long, and explained in many ways, though nobody had then devised a process whereby it could be used for the service of man on a large scale. The production of electricity in this generating station he submitted, fulfilled in the ordinary-accepted sense all the conditions of manufacturing a marketable article for sale, and fulfilled the conditions stated in the Acts before his Lordship. The Acts gave everybody who had engines in the vicinity of the canal, the right to draw water for generating steam, and the reason for giving such power under the Acts was that it would be for the benefit both of the trade of the neighbourhood, and also of the defendants, because it would increase the traffic on the canal. The generation of electricity had all the characteristics of a manufactory. A new article was produced from raw materials. A place was specially fitted and appropriated for that purpose, and the article produced was marketable. That being the case, he submitted the generating station came within the provisions of the Acts in question.

Mr. Cripps, K.C., submitted that the manufactures alluded to in the Act were the then existing manufactures within 200 yds. of the canal. An electrical generating station could not be described as a manufactory under the provisions of the Acts referred to. The electric current or force or transmission of power was not a manufactured article at all, nor did it purport to be. The plaintiffs wanted condensing power, not to produce a manufactured article, but to produce electric current. They were not entitled to take water for that purpose. All electricity was energy. It was not a manufactured product. In this case the Corporation were to use steam engines for generating power, which afterwards would be used for generating purposes. It was proposed to use the water to alter the force of power from steam to electricity. Under the Acts the Corporation were not entitled to do that. The matter was an extremely important one. If the Corporation wanted the use of the water of the canal for the purposes of their station, they must make a commercial bargain. They were not entitled to the free use of it under the Acts. He submitted that according to the true construction of the Acts, the use of the water was limited to the condensing of the steam of steam engines employed in their existing manufactures of Birmingham or in the corn mills. If there was no such limitation, then the meaning of the Acts was a place where manufacturing process was carried on. A generating station was not a manufactory at all. It did not manufacture an article or product. All that was done was to create a power to be used afterwards for some purpose, it might be three or four miles away from the canal. At the time the Acts were passed the total power used in Birmingham for these engines was 2,700 h.p. For this generating station he understood they wanted 32,000 h.p.

Mr. Parker said he was told they only wanted 12,000 h.p.

Mr. Sargant thought the exact horse-power was 13,700. There were three purposes for which the power was to be used, namely, for lighting, for tramways and for sale to persons for use in manufactories. The amount of water necessary would be about a quarter of a million gallons an hour.

His Lordship intimated that he would take time to consider his judgement.

Callender's Cable and Construction Co. *v.* Killarney Electric Lighting Co., Ltd.

On May 16th, at Dublin, the Master of the Rolls made an order on behalf of the plaintiffs that the purchaser of the undertaking of the defendants should be put into possession of same, and that the receiver should pass his final accounts and be thereupon discharged.

Hayward *v.* Ealing Corporation.

Before Mr. Justice Grantham and a special jury in the King's Bench Division on Friday, Mr. Thomas Hayward, described as a fruiterer, sued the Mayor and Corporation of Ealing to recover damages for injuries alleged to have been sustained through an electric shock. Mr. Bankes, K.C., and Mr. Turner, appeared for the plaintiff, and Mr. Dickens, K.C., and Mr. Herbert Smith, were for the defendants.

In opening, counsel stated that the plaintiff was standing outside his shop on April 30th with one foot upon one of the electric light inspection and cable boxes. It was extremely wet at the time, and it was alleged that plaintiff received an electric shock, which caused his leg to give way. He was thrown down, and his knee cap was broken. The defendants denied any negligence on their part. Evidence having been given by plaintiff, his wife, Mrs. Sophie Hayward, recounted what Messrs Poole and Lewis, electric experts, said after completing their examination of the box. Both agreed that the leakage was not sufficiently strong to have caused the accident. Mr. Poole had, however, been in her shop an hour before, and said there was a strong leakage. About 4 o'clock the same afternoon two workmen in overalls, and two gentlemen who appeared to superintend, made an examination of the box, and subsequently closed it down.

Dr. Stanley, who performed an operation upon plaintiff two days after the accident, said the patella was broken straight down. There seemed, in that particular case, to have been a muscular contraction behind the knee in the first place, and plaintiff had made a slight jump to recover himself, with the result that the bone was broken.

Cross-examined by Mr. Dickens, K.C., Witness said the muscular contraction might have been caused by electric current, and it might have been the result of a slip. He had seen two horses electrocuted in Marylebone through stepping upon the cover of a box similar to that in the present case. In his opinion, 100 volts was not sufficient to cause death, but was calculated to do injury. He had received a nasty shock in his own house while busy upon the electric wires. He had experienced a severe shock from 100 volts.

Mr. Justice Grantham: If 100 volts is enough to give you a nasty shock, then 200 would be much worse. We shall have to look out when touching our private installations.

Mr. Frederick P. Nicholson, M.I.E.E, of 53, Victoria Street, said he had had considerable experience in the laying of electrical mains. He had been shown a plan of the electric box, and had observed how the cables were placed. There were two T joints and two joints in the length of the cable. It was quite possible for a man to receive a severe shock from the cover of a box. Some people were more susceptible to electric shock than others. It was quite possible for plaintiff to have received a shock from the cover in the manner described.

Cross-examined: Assuming that the box lid was in contact with the earth and the positive wire was leaking and in contact with the cover, a person would not receive a shock.

Examined by Mr. Bankes, K.C., Witness said that leaks in a system usually occurred at the joints. Sometimes these were due to damage sustained by the wires in being drawn through the pipes. He could not understand the reason for the joints, but the dead ends, he presumed, had been made through a house service being disconnected. Much depended upon the difference of potential between the cover of the box and the pavement. If the cover of the box was not such a good conductor as the pavement the man could not get a shock. It was quite possible, in his judgement, that an electric shock might be conducted to the man while he had one foot on the box and the other on the pavement.

Mr. Ernest J. Taylor, A.I.E.E., assistant engineer to H.M. Board of Works, said that when he was connected with the Salford Corporation, a number of leakages in systems had come under his notice. In many of these cases leakages occurred at joints. It was quite possible for plaintiff to have received a shock in the way indicated. Had the cover been a "perfect earth" there would have been no shock. Witness then explained the meaning of "perfect earth," and cited, as an example, the measures taken to secure this in the case of a lightning conductor. He agreed with the evidence given by Mr. Nicholson.

By Mr. Dickens: Upon examining the box in question in December he found no leakage whatever. If there were no leakage there could be no shock. If the resistance of the earth were less than the resistance of a man's body, the current would of necessity run to earth.

For the defence, Mr. James Swinburne gave it as his opinion that it was impossible for a person to receive a shock from a box unless there was metallic contact. From the plan shown him, he concluded that it was impossible for there to have been this contact. A shock that was strong enough to break a man's knee-cap was sufficient to double him up.

Dr. Stanley, recalled, said plaintiff must have had a definite slip from the box to have produced the broken knee cap; an ordinary side slip would not have caused it.

Dr. Wallace, a surgeon of Harley Street, said the breaking of the patella was a common form of fracture, and could result from

slipping on the pavement; and Dr. Bruce, in charge of the X-ray department at Charing Cross Hospital, spoke to a fracture of the nature as being frequently treated in the hospital. Assuming the accident in the present case to have been the outcome of an electrical shock, he would have expected to find injury to the muscles of the limb, or to both limbs. At Charing Cross Hospital electrical treatment was practised, and it was quite common for a pressure of 100 volts to be applied.

Mr. Percy Good, A.I.E.E., who was for two years in charge of the electrical testing apparatus at the Thames Ironworks, described the result of the examination he made of the box at Ealing in company with Mr. Lewis. Tests were made with the cover of the box, and no result whatever was obtained. He found the insulated material in perfectly good order. In order to make the test complete, he joined one wire of the telephone to the iron part of the box cover and then to the iron part of a post office box in the neighbourhood. Had there been a leakage the telephone would have revealed it, but not the slightest evidence of leakage was present.

Further evidence having been given on behalf of defendants, counsel addressed the Court, and the case was adjourned until Monday, when Mr. Percy Good was re-examined at some length upon the tests made by him at Ealing. Other witnesses gave evidence, and eventually, after addresses by counsel and a short summing up by his Lordship, the jury disagreed.

Borough of Wandsworth *v.* The London United Tramways (1901), Ltd.

This case came before Mr Justice Warrington in the Chancery Division, on Saturday, on a motion by the plaintiffs for an interim injunction restraining the defendants from breaking up any of the roads within the jurisdiction of the plaintiffs. It appeared that the London United Tramways Act, 1902, authorised certain extensions of the defendant company's lines in (amongst other places) Wimbledon, Merton and Kingston. Sec. 27 of the London United Tramways Act, 1901, by the Act of 1902 was incorporated in the latter Act. [The material portions of Sec. 27 are mentioned in our leader columns to-day, where we comment upon the case.] No new generating station was authorised by the Act of 1902. In March last the defendants gave plaintiffs notice that they should enter upon and break up certain roadways within the plaintiffs' district, so as to connect their tramways at a sub-station at Wimbledon with the central power station at Lot's Road, Chelsea, belonging to the Underground Railways of London Co., a distance of between 5 and 6 miles, which affected roads in the plaintiffs' district extending from Putney Bridge to Wimbledon Common. The plaintiffs' case was that defendants had no statutory power to break up or disturb streets in districts where they had not been empowered to lay a tramline, in order to obtain electricity from a generating station building to an independent company, and further, that no notices in accordance with the Standing Orders of the House of Commons had been posted up in any of the streets in the plaintiffs' district where it was now proposed to lay the electric cable prior to the application of the Act of 1902. The facts were not in dispute, the only question being the correct interpretation of Sec. 27 of the Act of 1902.

Mr. Cripps, K.C., and Mr. Lyttleton Chubb appeared for the plaintiffs, and Mr. Balfour Browne, K.C., Mr. Rowden, K.C., and Mr. Christopher James for the defendants.

At the conclusion of the arguments of counsel, his Lordship, in giving judgement, said no sufficient reasons had been brought forward by the plaintiffs to induce him to hold that the words "any generating station" in the section must be confined to "any generating station belonging to the company." He held that the latter part of Sec. 27 was in general terms, and that there was nothing in this part of it from which he could infer that the general words used were to have any less or more limited meaning attributed to them. He thought the defendants had power to execute the works necessary for connecting their system with the generating station at Lot's Road, Chelsea, and he refused the motion.

Mr. Balfour Browne said that if plaintiffs chose to appeal, and did so promptly, defendants would not at present proceed to break up the streets to lay the cable.

It was arranged that if plaintiffs did elect to appeal, notice of appeal should be served within 14 days.

Swansea Corporation *v.* National Telephone Co., Ltd.

In the Chancery Division, before Mr. Justice Buckley on Monday, May 22nd, this case was mentioned. On May 11th, his Lordship declared that the plaintiffs were entitled to be afforded by the defendants all proper facilities for restricted intercommunication, and ordered that the defendants do give such proper facilities (see Elec. Rev., May 19th, p. 801).

Mr. Astbury, K.C., for the defendants, said his clients had decided to go on with the appeal, and they now asked his Lordship to say what should be done in the meantime. Evidence had been obtained as to the cost of carrying out the order. They were not trying to get out of the order, but were getting the evidence for the purpose of seeing what ought to be done pending the appeal. In view of the importance of the matter, the Court of Appeal might possibly expedite the hearing. Their evidence was directed to showing what would have to be done to make the connection intimated in the order. Mr. Swinburne, who did not give evidence at the last trial, and Mr. Gill, had gone into the matter. It would be necessary for the defendants to supply at the Swansea junction a switchboard which would have to be worked with special connections. There would also have to be a special transfer line operator to each switchboard, as the National Telephone Co.'s system was not worked the same as the Corporation's. In addition, there would have to be a sufficient number of branch lines to enable the whole system to be worked at once. It was estimated that it would take 26 weeks to get these things into working order. The manufacture of the switchboards was the most difficult part, as the difference between the two systems made automatic signalling necessary. The defendants did not want anything unreasonable, but they asked the Court to help them a little by limiting the number of connections to be made at once. At present the Corporation had 217 pairs of junctions. The defendants suggested that if half these were dealt with, the work could be done much more speedily. That would be sufficient for the plaintiffs' plan for a time, and the transfer boards would be of use if the defendants' plan was ultimately adopted.

His Lordship said he had expressed the opinion that everything ought to be immediately done to effect a junction at Swansea.

Mr. Astbury said his clients were prepared to go further than that, and make the connection with Mumbles and Morriston as well.

Mr. Buckmaster, K.C., in answer to a question by the judge as to what the plaintiffs wanted, said his clients only got the defendants' affidavits on Saturday last, and had not had time to consider the matter properly. They did not want to put the defendants to unnecessary expense. All they wanted was that a reasonable number of junctions should be given them. His expert evidence, which he had not had time to put into writing, was that 26 weeks was an unreasonable time to do the necessary work.

His Lordship, after further discussion, said the matter had better stand over to enable the plaintiffs to answer the defendants' evidence. When that had been done, if the parties could not agree upon a figure, he would say what he was prepared to do. Both parties appeared to desire to be reasonable, and his order was that everything should be done to put the Swansea line in operation as speedily as possible. The application would stand over until Thursday.

In *re* Brooker & Goss, Ltd.—Puxon *v.* The Company.

In the Chancery Division of the High Court of Justice on Tuesday, Mr. Justice Swinfen Eady had this case before him. Mr. Williamson said this was a debenture-holder's action, and it came on as a motion for judgement in default of defence. A receiver had been appointed. The company was a small electrical one, formed in 1903, and had power to issue debentures. Plaintiff's debenture was dated in 1904, and was for £300. One of the other debenture-holders, named Hough, joined. The company were to pay in 1910 the principal and interest, and the charge was on their undertaking, both present and future, including unpaid capital. There was a provision that the principal money of the plaintiff should rank *pari passu* with two debentures which had previously been issued to Mr. Hough and Mr. Esmond. The company was hopelessly insolvent, and the money on the debentures was unpaid. He proposed that his Lordship should make a declaration that the plaintiff and other holders of the first-mentioned debentures of the same issue were entitled to a charge on the undertaking and property of the company for securing the repayment of the principal moneys and interest.

His Lordship made the declaration, and directed the usual accounts and inquiries.

Mayer *v.* Haine & Co.

At the Marylebone County Court on 16th inst., this case was heard. It was a claim for £71, the cost of re-wiring premises at a residence at Bexhill, which had been wired by defendants in 1899, and upon which a short developed, causing a small fire in 1903. Defendants were told to spare no expense, but to put in the best possible material. Expert evidence was called to show that the insulated wire taken out, was not in the condition it should have been in after only five years' use. A fire insurance expert said that the residents were living on a mine. The defence was to the effect that the best possible material had been used. Some of the wire was G.E.C., and some Silvertown, and any deterioration must have been caused by damp. The house was empty for some years. Judgement was given for plaintiff for the amount claimed, less £10.

Pressland *v.* Edmundson's Electricity Corporation, Ltd.

In the King's Bench Division of the High Court of Justice on Tuesday, before Mr. Justice Wills, sitting without a jury, this case, which was an action to recover about £15,000 commission on the carrying out of a large electrical supply scheme in Lancashire, came on for hearing.

Mr. Witt, K.C., and Mr. Ashton were counsel for plaintiff, and Mr. C. A. Russell, K.C., and Mr. Geo. Wallace appeared for the defendant company.

Mr. Witt said the plaintiff, Mr. Wm. Thos. Pressland, was an electrical engineer, and the action was brought to recover commission and remuneration for services rendered, from the defendant company. He thought he might safely say that both the plaintiff and the gentleman who represented the defendant company were on the most friendly and amicable terms, and that all they wanted was a decision as to how much ought to be paid to the plaintiff for the services he had rendered, or as to what rate or standard of payment he was entitled to. His client said he was entitled to be paid at a higher rate than the defendant company said he should be paid at. The plaintiff's claim was for money alleged to be due from defendants to him under an agreement dated August 6th, 1897, or alternatively a *quantum meruit* for services rendered and for an account. The defendant company were contractors in a very

large way for the erection of works for the supply of electricity. About the date named they employed plaintiff for the purpose of promoting schemes for the establishment of electric lighting, traction and other works in various parts of the country, and obtaining the necessary Parliamentary powers, upon the terms that the defendants should pay him 5 per cent. commission upon the amount of such contracts as they should enter into. In the early part of 1898 the plaintiff introduced to the defendants a scheme of great value and importance for the establishment of electric supply stations and other works in a district extending about 20 miles around Wigan. The scheme was accepted by the defendants, and the plaintiff worked upon it during the years 1898, 1899 and 1900. The scheme was brought to a successful issue as the Lancashire Electric Power Co., Ltd., which obtained Parliamentary powers in 1900 to carry out the works. In October, 1903, the defendants entered into a contract with the company he had just mentioned to carry out certain works in connection with the scheme to the amount of £300,000, and plaintiff said that he thereupon became entitled to a commission of 5 per cent. on that sum under his agreement. Alternatively he said he had performed the work at the request of the defendants, and he asked for a reasonable remuneration for his services. In fact he claimed £15,000 commission, or a *quantum meruit* for services rendered. He might say that during the time plaintiff had been connected with the defendants they had paid him something like £20,000, and that until the present case arose there had never been any trouble or difficulty. The Wigan or Rossendale scheme was a great scheme embracing an expenditure of about three millions capital.

Mr. Wm. Thos. Pressland, the plaintiff, was called, and gave evidence in support of his counsel's opening statement. He said he had been engaged in electrical undertakings since 1881. He gave details as to the promotion and carrying out of the Rossendale scheme. He said there were in the district 122 local authorities, and he saw the officials of a great number of them. The area was about 1,000 square miles. He gave particulars as to his work in connection with the formation of the scheme and the carrying of a Bill through Parliament.

Mr. Arthur Smith, solicitor, clerk of the peace and late town clerk of Wigan, spoke to plaintiff's connection with the electric power scheme for the district. He discussed the matter many times with Mr. Pressland, who was instrumental in carrying it out. The hearing was adjourned.

On Wednesday, Mr. Russell, K.C., for the defendants, contended that it was not by reason of anything done or suggested by Mr. Pressland that the Lancashire Power Bill came to be promoted. He had been paid all out-of-pocket expenses due to him, and defendants had paid a sum into Court which, they said, was sufficient to cover all liability. Counsel submitted that plaintiff was not entitled to claim commission under his agreement of 1897.

Mr. F. E. Gripper, managing director of the defendant company, said that they agreed to join the syndicate as third parties, and arranged for plaintiff to do canvassing and other work at a reasonable remuneration. There was never any arrangement to pay him commission.

Mr. J. Sturgeon, civil and electrical engineer, Leeds, said that he prepared an electrical supply scheme for South Lancashire in 1898. Mr. Pressland gave no engineering or electrical assistance at all.

His Lordship said he did not think the work in question came under the agreement of August 7th, 1897, or under any specific contract which fixed any rate of remuneration at all. He thought that a jury would in all probability have awarded plaintiff £1,200, and he gave judgement for that amount, with costs.

Mr Wallace: I may now tell your Lordship that we had paid into Court £1,100.

His Lordship ordered the payment out of Court to the plaintiff of that amount.

PARLIAMENTARY.

LONDON ELECTRIC POWER BILLS.

(*Continued from page* 828.)

Central Electric Supply Co.'s Bill.

Tuesday, May 16th.

Mr. Boulnois was further examined: If they got their powers it would mean that they would be able to sell much more cheaply to the affiliated companies than they did at present. There was no maximum price in the Bill for bulk supply, but there was a clause which provided that should the company and any authorised undertakers fail to agree upon a price, they should appeal to the Board of Trade to fix the price at which the supply should be given. The present price to the two affiliated companies was practically cost price, with a very small margin for profit.

The Hon. J. D. Fitzgerald, K.C.: The Westminster Co. could, if they liked, take the whole of their supply from the Central Co.? —Witness: Yes.

Mr. Fitzgerald then suggested that the two companies could generate more cheaply than they were supplied by the Central Co. —Witness could not say.

The Chairman remarked that the matter was perfectly clear. The two companies had started the Central Co. for the purpose of supplying their peak load. They had their own generating stations and if they did not generate in them, they would have to scrap them. Evidently, as business men, they would take what supply they could from their own station, and come on the Central Co. for their peak demand when they found it necessary.

Re-examined: He did not think it would be fair to give power to the Administrative Co. to supply the authorised undertakers in their district, and to deny that power to them.

Dr. Kennedy, the joint engineer with Mr. Dobson, of the Central Co., was then called. He said that the present capacity of the station was 8,600 kw. They were using the station to the extent of about two-thirds of its capacity. Their site was being used to the extent of about one-fifth of its capacity. They had the foundations put in for a second set of buildings, and a railway siding had also been made. The area of the site was 7 acres.

The Chairman: Then what was it you had in mind when you bought the seven acres? You did not want the whole of that for your peak load?—We had in mind an increase in the peak load.

Further examined, Witness said that, allowing for spares at the present load factor, the company could from its existing station sell 19 million units per annum. The works cost and management and general expenses he estimated at ·62d. per unit. Interest and sinking fund and so on would be ·26d., or together a total of ·88d. The company had an agreement with the Regent's Canal Co. to take water for the purposes of condensing, but they had not utilised that agreement, because as yet they had not got statutory powers over that part of their site on which they wished to erect the condensers. In the case of Victoria Station, he thought that a special main would be required if the demand were large. If it were not laid by the Central Co it might be laid by the Westminster Co. They could use an existing main to within 150 yds. of the station. At present Victoria Station was supplied for lighting but not for power.

Cross-examined by Mr. Fitzgerald: At present their station was a non-condensing one. He did not know exactly how much hot water they would have to turn back into the canal. He would have to work it out.

Re-examined: They could use their present plant without condensing. He designed the general scheme of the station, and its capacity, except for peak purposes, was a long way from having been reached.

In reply to Lord Zouch of Harringworth: It was generally desirable to have separate mains for lighting and power, because the power load was very often "jumpy," and would affect the steadiness of the lighting. In the case of small motors it did not matter so much; as an illustration, he mentioned that the fans for ventilating the Houses of Parliament were worked from the same mains that supplied the electric light.

Mr. Frederick James Walker, secretary and manager of the Central Co., was called to show that the object of the company in laying out the land on the Regent's Canal was that it should form the nucleus of a very large station to supply in bulk. They had been refused power to supply in bulk, but they had always had the intention of coming to Parliament again.

This concluded the case for the promoters, and the Hon. J. D. Fitzgerald addressed the Committee on behalf of the Administrative Co. He said that the company was to all intents and purposes in the same position as another company which their Lordships heard about last session. They had heard of a Wood Lane station which had been erected by two companies for the supply of Kensington. Something of that kind might have been done in this case; but instead, the companies decided to form a separate company. Parliament had said that the company should serve in the useful and humble capacity of supplying the peak load to the two companies. They had accepted the decision of Parliament, but now they wanted to be given a further status, and to have an area of their own. They proposed to supply in St. Pancras, and although St. Pancras was an industrial area, they did not propose to supply any of the manufacturers there. He asked if it was likely that the company could ever get into the position which the Administrative Co. would be in.

Mr. Freeman, K.C., on behalf of St. Pancras and Marylebone, said that those local authorities were now equipped to supply their own districts. As to the proposed second main, he would not say anything about it. If their Lordships thought that it was a public necessity, it was for them to say so. He concluded by remarking that if the company were allowed to supply railway companies, it would mean that they would cut up streets for the purpose of laying mains.

Mr. Blennerhassett, K.C., for Westminster, then addressed the Committee on the question of purchase. It was a question which involved a great principle, and he asked their Lordships to give no decision upon it, but to leave the matter where it was. The company had accepted the purchase clause in their Act of 1899, and they had no right to ask that it should be struck out now.

Mr. Moon, K.C., in reply, asked the Committee to consider the interests of the consumers in the districts under consideration.

This concluded the case for the Central Co., and the Committee decided to defer their decision. (Further consideration of this scheme took place after the decision had been declared, and it is reported on page 843.)

County of London Electric Supply Co.'s Bill.

Mr. Moon, K.C., then opened the case for the County of London Co.'s Bill, and in doing so, said that he must congratulate their Lordships on having arrived at the last of the Bills. The Bill was different in some respects from the Bills which the Committee had had before them, inasmuch as it contained more of a domestic

character as regarded the company itself. The company also sought power to supply in bulk, but all their bulk powers were to be outside their area. The company had two generating stations, one at Wandsworth and one in the City Road, at the north of Finsbury. By Clause 10 the Bill provided that the company should be able to increase the capacity of both of those stations, and that part of the Bill was unopposed. Another part which was unopposed was that relating to the keeping of one account for Holborn and Finsbury instead of two. Counsel went on to describe what the promoters proposed to do in the way of connecting up the two stations at City Road and Wandsworth. That was a very important matter for the company, for the connecting up of the two stations would mean that great economy, and consequently lower charges, would result. There were some hours of the day when one station would suffice for the whole of the area, and, in fact, he believed that, for certain months of the year, something like four, one station would be sufficient. On the question of supply in bulk, the learned counsel said that at the present time the company had as customers many of the large railways companies, among them the Great Northern, the City and South London, the Great Northern and City, and the Great Western. They had had negotiations pending with the London and Brighton Co. for a supply for part of their line, but when it was found that it was uncertain that the company could legally supply them the negotiations were broken off. In the same way they had had negotiations with the South London Tramways Co., and these also had come to nothing. It was absurd to expect a company to take a supply for part of their line. The advantage of a traction load was well known to those who ran generating stations, as it enabled the cost of supply for other purposes to be reduced. The company proposed to add to their area Battersea, Lambeth, Southwark, City, Shoreditch and Hackney, and they sought power to supply in bulk to any authorised distributor in those districts, for use either within or without the area. One other matter which the company had on the Bill was the erection of a generating station at Tottenham for the purpose of still further increasing their output. It was proposed to build a station with a capacity of 70,000 KW. Counsel then dealt at great length with the opposition of the Administrative Co. He said that it would not be denied that the ideal conditions for the manufacturer were for him to be in a position to obtain a supply generated by those who could generate most cheaply, and distributed by those who could distribute most cheaply. That was what the County of London Co. were offering to the manufacturer, for they did not allege that they could distribute more cheaply than the local authorities who had their own mains.

At the conclusion of learned Counsel's speech, Mr. RAM, K.C., asked the Committee if they would consider the question of the *locus* of the L.C.C. before witnesses were called.

After consideration, the Committee decided to allow the L.C.C. a limited *locus* in respect only of streets and sewers.

Mr. SPARKS, the chief engineer to the County of London Co. was then called. He said that when the company got the proposed area it would make their total area 100 miles square, in which area there would be 2,956,000 people. The systems of generation at both of their stations were the same, so that there would be no difficulty in connecting the two. Referring to the site at Tottenham, witness said that it was situated on the River Lea. The station would be put up in 10,000 KW. sections, and would ultimately have a capacity of 70,000 KW. There would be no difficulty in taking the connecting main through the City, but they had not in their Bill selected any special route. Being a trunk main, there would be little inconvenience from inspection. There was plenty of room for their mains in one of the footways of Blackfriars Bridge. Witness then put in a number of tables showing the number of boxes which would be required on the route of the proposed main; and also the cost of transformation, &c. He estimated the total cost of generation at ·76d. per unit.

Wednesday, May 17th.

Mr. SPARKS continued his evidence, and in reply to the CHAIRMAN, said that if the extended area were refused, it would still be of great importance to the company to have powers to supply authorised users, namely, the railway and tramway companies.

Cross-examined by Lord ROBERT CECIL, K.C. (for Camberwell): The company did not propose to alter the position of Camberwell at all.

In reply to the CHAIRMAN, Lord ROBERT explained that at the end of the 42 years provided by the Act, Camberwell, although there was a sub-station within the area, would have nothing to purchase. His contention was that at the end of the period, Camberwell would be called upon to pay for a portion of the generating station at Wandsworth. To that his clients objected. Camberwell understood at one time that there would be a generating station within their own area.

Further cross-examined, WITNESS said that the promoters proposed to supply an authorised undertaker in their Camberwell area for distribution in Lewisham.

In reply to Mr. LLOYD, K.C.: Their maximum price at present was 7d., but he had been advised by the company's legal adviser that they had limited their power to charge to 2½d. The maximum for the additional area was probably not more than 8d., and certainly not less than 6d. He had compared his maximum prices (in the Bill) with those of the Administrative Co. He disagreed with the way in which the Administrative Co. had set out their tables. If the tables were right, then the prices of the Administrative Co. were lower than those of his company.

Mr. HONORATUS LLOYD: You have no sliding scale?—No, we have not.

Do you propose to use your existing mains for the purpose of supply under this Bill?—Yes, specially for ourselves.

And those mains at present are purchasable by the local authorities?—That is so.

Mr. HONORATUS LLOYD suggested that the use of the mains would cause difficulty in regard to the purchase, but WITNESS could not agree; the mains would only be so used at present. They would be laying fresh mains ultimately.

By Mr. RIGG (for the Corporation of London): They had included the City in their additional area, because they were proposing to lay their mains through the City. It would have the option of taking a supply.

Mr. RIGG: But why do you propose to lay your mains through the City? Why could you not go round?—WITNESS replied that it was the nearest way for the mains to go.

In reply to further questions by counsel for the City, WITNESS said that the company might supply some of the tube railways in the City.

Mr. RIGG: What is there which this Bill will do for the City which Mr. Merz's scheme will not do?—I don't know anything about Mr. Merz's scheme.

Mr. SYDNEY HOLLAND (for the Charing Cross Co.): The area which you propose to take is something like Euclid's definition of a line, "Length without breadth"?—If 8 miles is without breadth. We shall supply the adjoining areas.

Mr. HOLLAND remarked that that would be at the expense of the existing companies. The company might be called a "sucker" company.—WITNESS: We shall *aid* the existing companies.

Mr. HOLLAND: Then I will call you a "succour company," and we are friends again.

In reply to Counsel for Croydon, the WITNESS said that he would have no objection to making it perfectly clear that no mains should be laid in that borough.

Re-examined: He thought that it would be only fair for the company to be called upon to give a supply to authorised undertakers in those areas through which their mains went. As to the connecting up of the two stations, Lord Cross's Committee had recommended that such powers should be given to companies. If Battersea were excluded from the Bill, it would mean that the connecting main would cost an additional £30,000.

Mr. MURPHY, a director of the South London Tramway Co, was called, and said that if the Bill were passed they would, providing that the prices were reasonable, take their supply for their tramways, when electrified, from the County of London Co.

Mr. SHAW then said that he did not propose to call any more witnesses.

Mr. HOLLAND objected that he wished to see further witnesses, but the CHAIRMAN said that the opposition would have their opportunity to reply.

Sir RALPH LITTLER, K.C., then proceeded to address the Committee on behalf of the Corporation of London. He dealt with the congested state of the streets in the matter of mains as well as traffic, and asked the Committee to say that the promoters had no right further to increase that congestion and to add to the already large number of companies who had powers to break up the streets of the City.

Mr. HONORATUS LLOYD, on behalf of the Administrative Co., contended that the Bill of the promoters was on a wrong base. What was wanted was a company with a comprehensive area. The Bill did not propose to meet the demand of the manufacturer. It was a Bill promoted to place in the hands of the middleman a supply of electricity at a low cost, the middlemen being practically the promoters of the Bill themselves. What they really wanted to do was to supply themselves so that they might give a cheap supply to the middleman, and there was no proposal to deal with the manufacturer as the manufacturer ought to be dealt with. There was nothing in the Bill which would give the manufacturer right to call for a single unit of electricity. That was what would happen in the existing area of the company. In the proposed added area, things would be very little better, for then the manufacturer would only be able to demand a supply in accordance with the existing provisional orders. He admitted that the joining up of the stations was naturally a part of the development of the undertaking, but he objected to the proposed station at Tottenham. There they were to all intents and purposes a new company seeking new powers. Continuing, counsel said that it was evident that someone should have power to supply authorised undertakers within the company's existing area; and he was perfectly willing for that power to be given to the Administrative Co. in competition. The advantage of giving the power to a new company was that there was no difficulty with regard to the question of purchase.

Lord ROBERT CECIL addressed the Committee on behalf of a number of local authorities. Dealing with the case for Camberwell, he said that the prov. order of 1896 was consented to on the express terms that there should be a separate undertaking for Camberwell, and he contended that the company had really attempted to avoid the purchase clause.

Learned counsel called Mr. HAYWARD, the borough engineer to Battersea Council, who spoke as to the congestion of pipes, &c., in the streets, and said his council objected very strongly to any further company having powers to open the streets.

Mr. TAGG, the Town Clerk of Camberwell, was called on behalf of the opposition of that borough, and during the course of his cross-examination

Mr. BALFOUR BROWNE said that the County of London Co. did not propose to use their enlarged sub-station at Camberwell for any other purpose than that of the supply of Camberwell.

Mr. VESEY KNOX, addressing the Committee on behalf of the South London E. S. Co. and the Borough of Southwark, remarked that it was difficult to understand why the company should be given the power they sought. If some extension of powers was necessary, it should be given to all the companies, and not to one only.

Mr. Sidney Holland, for the Charing Cross Co., said that the real object of the Bill was to get into the City. He regretted that Mr. Braithwaite had not been put into the witness box, for Mr. Braithwaite was the Bismarck of the electric lighting world, and it was to help his City Co. that the Bill had been promoted. The promoters could supply the City Co. with current, while the Charing Cross Co. could not compel them to give a supply. It was really a very great injustice.

Mr. Balfour Browne said that although he had no right of reply on his learned friend's speech, he would like to say that it was absurd to suppose that the purpose of the Bill was to buttress up the City Co. Dealing with the opposition of the local authorities in the cases where witnesses had been called, he said that the position of Camberwell was perfectly clear, but there was not one word in the provisional order for that place about a separate generating station for the district. With regard to the City, it was only right that authorised undertakers there should have an opportunity of obtaining a supply in competition.

At the conclusion of the learned Counsel's speech, the Earl of Camperdown remarked that he would ask counsel to attend on the morrow, and he should be glad if, while the Committee were considering their decision, someone from the various companies could be in attendance to answer any questions of fact.

The room was then cleared, and the Committee commenced their sitting in private.

Thursday, May 18th.

The proceedings for this day appeared in our issue of last week on page 817. The report was inserted just as we went to press with the last sheets, so that our readers might be early acquainted with the Committee's decision.

Friday, May 19th.

Earl Camperdown's Committee considered the clauses of the County of London Bill. The decision of the Committee the previous day caused the clauses giving the company powers to supply within the City of London, the Metropolitan Borough of Hackney, Shoreditch, Southwark, Lambeth, and Batterses, and the Urban District of Tottenham to be withdrawn, and left powers for the acquisition of certain lands in Camberwell, the erection of generating stations in Camberwell, and the abstraction of water from the Regent's Canal, &c.

Mr. Moon (for the company) said that Clause 24 of the Bill had reference to the sanctioning of electric lines in Lambeth, and were put in in order to protect the interests of Lambeth. It would have made the payment of £100 per year to that Borough Council in perpetuity.

Lord R. Cecil said that at present the lines were there by consent on the payment of a certain annual rent.

Mr. Moon said that as Camberwell was objecting as well as Lambeth, he would withdraw the clause.

It was agreed to insert a new clause, described as the stand-by clause, as follows:—"Nothwithstanding anything in the Electric Lighting Acts of 1882 and 1888, or in any of the Companies' Acts, a person shall not be entitled to demand, or to continue to receive from the company, a supply of electricity for any premises having a separate supply, unless he has agreed with the company to pay to them such minimum annual sum as will give them a reasonable return on the capital expenditure, and will cover other standing charges incurred by them in order to meet the possible maximum demand for those premises. The sum to be so paid shall be determined in default of agreement by arbitration under the Electric Lighting Act, 1882."

Mr. Moon pointed out that this was the clause which was contained in the Electric Supply Bill now before Parliament, and was being put into Electric Lighting Orders of the Board of Trade.

The Chairman asked if the clause were verbatim, because it was most desirable that the clause should be identical in both this Bill, and that of the North Metropolitan Company.

Lord R. Cecil remarked that the wording of the clause proposed was better than that in the North Metropolitan Bill.

The Chairman said the Committee would mention the matter in their report to the Lord Chairman, and get the clause in the North Metropolitan Bill amended.

The following new Clause 16 was agreed to: "The company may at any point or points within any area of the supply for the time being of the company supply electrical energy for the purpose of haulage or traction, and for lighting vehicles or boats drawn by such haulage or traction of any company, body or person owning or working any railway, tramway, tramroad, canal or navigation situated within or partly within such area of supply, and notwithstanding that such energy is to be used for such purposes, in part outside such area of supply; provided that the company, body or person receiving such supply shall not use the electrical energy so supplied for other than the aforesaid purposes."

Mr. Moon also brought up the following new Clause 13 *f*: "Provided that the lands in the Metropolitan Borough of Camberwell described in the Act shall be used only for the purposes connected with the supply of electricity within the Metropolitan Borough of Camberwell." He said that, although the promoters had agreed to that clause, they were not satisfied. It seemed to be impossible to come to any conclusion which would be reasonable to them, and so they made the best of a bad job.

The clause was agreed to, and the Bill, as amended, was ordered to be reported to the House.

Central Electric Supply Co. Bill.

Mr. Moon, K.C., who appeared for the promoters, said he would like to know what really was the effect of the Committee's decision as to this Bill. In the Bill they were asking for powers to supply authorised users—such as railways and canals—in St. Pancras and Marylebone, where the company had no area. They were also asking for similar powers in that part of Westminster which was supplied by the Westminster Co. and the St. James' Co., which constituted the Central Electric Co. He apprehended that in reference to St. Pancras and Marylebone, the effect of the decision was that they would get no powers to supply authorised users in those two districts.

The Chairman: Because that would imply that you have an area in St. Pancras and Marylebone, whereas you have none.

Mr. Moon said what occurred to him was that the position in that part of Westminster supplied by the two companies was different.

The Chairman: Is not the position that you have no area in Westminster but that you supply two companies who have areas in Westminster?

Mr. Moon: I supply myself in Westminster, for I have an area there.

The Chairman: We do not desire to take anything away from you which you have. We were under the impression that you had no area, but were merely supplying two companies who had.

Mr. Moon said they supplied electricity to two companies who really constituted his company; but these two companies had not the powers which the Central Electric Co. were asking for.

The Chairman: And you ask us to give additional powers to the two companies you supply.

Mr. Moon: My son and daughter.

Mr. Freeman: They are older than the parent.

Mr. Moon: Then my grandfather and grandmother. All I want to know is whether your decision negatives that or not.

The Chairman said the object of the Committee was to leave things exactly as they were, and he understood that Mr. Moon asked them to give powers to the grandfather and grandmother, but under a different name. That, he thought, the Committee could not do.

The Committee proceeded to deal with the clauses in the Bill.

Mr. Blennerhasset, on behalf of the Westminster Corporation, asked that the Electric Lighting Acts of 1882 and 1889 should be incorporated in the Bill.

The Chairman said the Committee had not given the company an area, and therefore the question of purchase did not come in. The company were in exactly the same position as by their Act of 1899.

Mr. Blennerhasset pointed out that by this Bill the company got powers to erect an electric generating station, and also to lay a second main, and there was nothing in the company's Act of 1899 which would refer to the present Bill.

Mr. Moon said he would undertake that the generating station with respect to which they asked for powers should be in all respects subject to the same provisions as the generating station they had erected under the powers of 1899.

After some discussion, the clause brought forward by Mr. Blennerhasset was agreed to.

Some discussion took place over Clause 12, which provided that the company should only make two trenches for supplying the St. James' and Westminster Companies, and that 14 days' notice of the proposed line of route should be given to the local authorities, who should, with the consent of the Board of Trade, be able to lay down alternative routes if thought desirable.

The clause was amended to allow of one month's notice instead of 14 days.

The Committee adjourned till Monday.

The Administrative County and Metropolitan Bills.

Monday, May 22nd.

On Monday Earl Camperdown's Committee sat again to further hear the cases of the Administrative County of London Bill and the Metropolitan Electric Supply Company's Bill.

The Chairman said they adjourned on Thursday for the promoters of the two Bills and the representatives of the existing companies who were liable to purchase to consider whether they had any reasonable suggestions to make with regard to obviating the hardship which it was thought would be entailed upon the companies who were liable to purchase.

Mr. Fitzgerald (for the Administrative London Company) said he would read the correspondence which had taken place and would then call attention to the alterations which the promoters proposed to make in the Bill in view of what had taken place.

The Chairman said the Committee would like to know if there was any joint suggestion to make.

Mr. Balfour Browne, K.C. (who represented the existing electric lighting companies), said the companies had considered this matter very carefully. They entirely agreed that there would be a hardship, but they felt it could be obviated in no other way except by leaving out of the Administrative Bill the districts where companies liable to be purchased were already supplying. Therefore, there was no agreement come to between them at all. The suggestions which had been made by the Administrative Company, he ventured to say, were absolutely illusive.

Mr. Ram, K.C., said with regard to the Metropolitan Electric Supply Company's Bill, the difficulties had been overcome, for there was no opposition. In the Metropolitan Bill, so far as London was concerned, they did not propose to compete with the existing companies at all. In the Bill at first they did propose to supply in Kensington, for there were special reasons

why they wished to supply that district. Now, however, they proposed to strike Kensington out of the Bill, saving so far as they would ask to be allowed to lay pipes through Kensington. That would remove any question so far as the London proportion of the area was concerned.

The CHAIRMAN: In the London portion of the area you ask to supply, is there no company excepting the Kensington Company supplying?

Mr. RAM said they proposed to supply in Hampstead and Marylebone and Kensington, and it was only in Kensington that there was another company. In Kensington there were three different companies, each serving a different portion; but the Metropolitan Company had now voluntarily struck out Kensington from the Bill. All they wanted was the right to lay mains through Kensington, so that they could supply in districts beyond Kensington. With regard to the area they had scheduled outside London, there were three or four small companies in different portions of a large district, and they did ask to be allowed to supply to them. There was no objection from those companies, who would be glad to take their supply from his company. The difficulty therefore, so far as they were concerned, with regard to companies liable to be purchased was now at an end.

Mr. FITZGERALD said that so far as the small companies outside London were concerned, the Administrative Company were in exactly the same position as the Metropolitan Company. In fact, he thought those small companies were in a better position, because they were controlled by Edmundson's Electricity Corporation. He referred to places like Twickenham, Teddington, Isleworth, and so on. But to come to the substantial question before them, he might say that immediately after the Committee's decision was given on receiving notice from the agents of the existing companies, stating that they were meeting in one of the Committee rooms, and were prepared to consider any proposals which the promoters might have to make, the promoters replied, pointing out that their amended Clause 48 had not yet been considered by the Committee; and in framing those amendments they had had regard to the representations as to the hardships to the existing companies which were liable to purchase. They felt that the amendments were wide enough to cover the purchase question, but that to meet any possible difficulty they were prepared to put in another section, viz., Sub-section 48A, under which it would be possible for the Board of Trade to impose on the company such terms and conditions that the Board might think necessary for the protection of the distributors. Further, the promoters said that they would be pleased to hear any suggestions the companies might like to make. To this the following reply was received:—"We thank you for your letter making the proposal to obviate the hardships which the passing of your Bill would inflict on the existing companies whose undertakings are subject to purchase by the local authorities. We regret that we cannot regard this proposal as likely to obviate the hardship. The position has been very carefully considered by our clients, and we are unable to suggest a practical method for remedying the hardship so long as the areas of the companies subject to purchase are retained in the Bill." He proposed now to call the attention of the Committee to the effect of the promoters' proposals, taken as a whole, which they thought would enable the Board of Trade to deal effectively with the hardship which the Committee anticipated might take place. The amended clause, 48, was as follows:—"The powers of the company for the supply of energy shall be subject to the following provisions: (1) Energy shall be supplied under this Act only (a) for supply to authorised undertakers, and (b) for providing power to any person. (2) The energy supplied to authorised undertakers may be used by them for lighting or other purposes, and the energy supplied to any person for power may be used by such person for lighting any premises on any part of which the power is utilised; but save as aforesaid the company shall not supply energy for lighting purposes. Provided that where energy is supplied to any person for power within the area of supply of any authorised distributors, the energy used by such person for such lighting purposes shall not in any year, except with the consent in writing of the authorised distributors, exceed 20 per cent. of the total amount of energy supplied to such person; and save as aforesaid the company shall not supply energy for lighting purposes. (3) Energy shall not be supplied under this Act by the company (except to authorised undertakers or to the proprietors or trustees of any railway, tramway, or waterworks, or of any dock, canal, or navigation lawfully entitled to use energy, or to any Government department) in any area being at the passing of this Act the area of supply of any authorised distributors, except with the consent of those distributors, but that consent shall not be unreasonably withheld. If any question arises whether that consent is unreasonably withheld, that question shall be determined by the Board of Trade. The consent shall be deemed to be unreasonably withheld if the authorised distributors are not willing and in a position to give the requisite supply upon reasonable terms and within a reasonable time; and in considering what are reasonable terms and what is a reasonable time the Board of Trade shall have regard to all the circumstances of the case, including, amongst other things, the terms upon which and the time within which the company are willing and in a position to give the supply, and (if such be the case) that the undertaking of the authorised distributor is liable to be purchased under the principal Acts. (4) If at any time after the passing of this Act any local authority, company, or person become authorised distributors in any area within the area of supply under this Act, the company shall be subject to any provision which may be made by the Act or Provisional Order under which the distributors become authorised as to the taking over of any supply then given by the company for use exclusively within the area of supply of the distributors, or otherwise, as to the powers of the company to supply within that area, and such provisions may be made in any such Provisional Order under the principal Acts." This clause, in the first place, made it plain beyond any doubt that the Board of Trade were to consider all the circumstances of the case; and, secondly, it pointed out that one of the circumstances of the case to be considered by the Board of Trade was that the undertaking of the authorised distributor was liable to be purchased under the principal Acts.

The CHAIRMAN said he would like to know why the clause read "including, amongst other things, the terms upon which and the time within which the company are willing, etc." Supposing they put it, "including, amongst other things, that the undertaking of the distributor is liable to be purchased, etc." Would it make any difference with regard to the Board of Trade?

Mr. FITZGERALD said he did not think the order made any difference. If they pointed out certain things which were to be considered, it amounted to a direction that they were to consider these particular things.

The CHAIRMAN: And the effect of terms coming first would not mean that they were to consider terms before they considered that the undertaking was purchaseable?

Mr. FITZGERALD: Where there are three things to consider it does not matter which comes first.

The CHAIRMAN: I only wanted to make that safe.

Mr. FITZGERALD said he would now call attention to the new clause, 48A. That clause considered with the clause he had already made had a most material bearing on the matter which was in the minds of the Committee. The clause read as follows:—

"NEW CLAUSE, 48A.

"The following provisions shall apply and have effect in relation to the supply of energy by the company under the provisions of this Act within the area of any authorised distributor where the consent of such distributor has been withheld:—

"(1) Where the consent of any such distributor in such area has been refused, the company in making application to the Board of Trade to determine whether such consent has been unreasonably withheld shall deposit with the Board of Trade a statement of prices proposed to be charged by the company in respect of such supply throughout such area not exceeding the prices stated in the second schedule to this Act.

"(2) In dispensing with any consent under the section of this Act whereof the marginal note is 'Conditions affecting Supply,' the Board of Trade may, if they think fit, impose upon the company such terms and conditions as the Board may think fit and necessary for the protection of such distributor, and for affording a supply of energy under this Act throughout such area, and such terms and conditions may at any time be enforced by such distributor in any court of competent jurisdiction.

"(3) The company shall not, after commencing to supply energy within such area, increase the prices in such statement without the consent of the Board of Trade, which consent the Board of Trade are hereby empowered to give.

"(4) Where the Board of Trade have dispensed with the consent of such distributor under the section of this Act whereof the marginal note is 'Conditions affecting Supply,' the company shall, in respect of the supply of energy for providing power to any person within such area, be subject to the same obligations to afford a supply of energy as the authorised distributors therein.

"(5) The Board of Trade may, if they think fit, in any case where they have so dispensed with the consent of an authorised distributor require the company to lay within a period prescribed by the Board suitable and sufficient distributing mains in such streets within the area of such distributor as they think reasonable for affording a supply of energy to persons for power within such area."

It would be seen that Sub-section 2 was of the widest character. It did not limit the Board of Trade in any way. They could impose whatever terms and conditions they thought were proper and suitable, having regard to the special circumstances of the particular clause. Sub-section 3 met the point which was suggested in the course of the case that the company might by naming a low price get into an area, and when once they got into the area increase the price. Sub-section 4 again met the point that was made over and over again in the course of the discussion that they could come in and be under different obligations with regard to giving a supply of power than the authorised distributors. The total result of the amendments was that the Board of Trade had the widest possible power to deal with the circumstances of each particular case, and they were specially called upon to consider the case of the company whose undertaking was purchaseable by the local authority at the expiration of forty-two years. Of course it might be said that it left the matter in the hands of the Board of Trade, and so it did; but what they had to consider was the difficulty of putting in specific provisions saying what the Board of Trade were to do.

The CHAIRMAN said there were two ways of doing it. Either it might be left to the Board of Trade to deal with, or it might be dealt with in the Bill.

Mr. FITZGERALD said the point was that it was difficult to make specific conditions which would be applicable to each particular case, because the clause would be of general application. Supposing the promoters offered to supply in a district at 1½d. a unit, the existing company might say, "Having regard to the fact that we are purchaseable, we are not in a

position to supply at so low a rate, and you ought to give us a supply in bulk at a lower rate which would enable us to supply at the same rate as you, and therefore compete with you on equal terms." That was a proposition which the promoters would have no hesitation in agreeing to, but if they were to propose a specific clause dealing with that, a difficulty might arise, for another company might say they had no provision of the kind.

The CHAIRMAN said that because one company might be willing to accept it and another company might not was no reason why the clause should not be inserted.

Mr. FITZGERALD said that what he had in his mind was that the companies who did not want to accept would say that they had no protection at all. It would be quite open to the Board of Trade to lay such a condition on the promoters.

The CHAIRMAN said this might meet the authorised distributor, but might not meet the case of the private manufacturer in the industrial area.

Mr. FITZGERALD said it would be competent for the Board of Trade to say, "If you are going to supply the manufacturer direct, you must put the authorised distributor in the position to supply the manufacturer at the same price."

The CHAIRMAN remarked that it was a cumbrous way of doing it.

Mr. FITZGERALD said he did not think so. It would give the manufacturer two persons to whom he could apply for a supply at low prices, and there would be a competition in facilities. Unless the matter was left to the Board of Trade he foresaw the greatest difficulty in putting in a specific clause. There were a number of circumstances to be considered in each particular case. The Board of Trade would have to consider what was the load factor, the amount to be taken, and so on. The promoters thought their suggestion was the best way to deal with the hardship; but if the companies would make any suggestions they would be quite willing to consider them. Coming back to the Bill itself, he would point out that in the industrial area there were only four companies, and only 10 per cent. of their business was for power, so that with regard to the bulk of their business there was no competition at all.

Mr. RAM, K.C., said the existing companies considered it utterly unsatisfactory to leave the matter to the Board of Trade.

Mr. WALLACE, K.C., said his clients asked for the rejection of the Bill.

Mr. FREEMAN, K.C., said he was appearing for the local authorities, and he would like to know his position.

The CHAIRMAN: If you are not purchaseable, I do not think you come in.

Mr. BALFOUR BROWNE, in reply to the Chairman, said he would add nothing to what Mr. Ram had said.

The CHAIRMAN said that, so far as this point of the hardship to the companies was concerned, the Committee had decided that when they came to the clauses they would insert a clause in principle such as Mr. Fitzgerald had indicated. The Committee had decided that the two Bills might now proceed; and with regard to area, they had decided to give to the Administrative County of London Company an area which was known as the industrial area on the north of the Thames, and also the non-industrial area on the south of the Thames. To the Metropolitan Electric Supply Company they would give the non-industrial area north of the Thames, which was practically what they asked for. The point where some difficulty might arise was with regard to the Administrative County's generating station at Fulham, but he apprehended that it would be possible to supply an area on the south side of the Thames from Fulham.

Mr. BALFOUR BROWNE said that he took it that the little portion of Stoke Newington which had been given to the North Metropolitan Electric Supply Company would be excluded from the Administrative County's Bill.

The CHAIRMAN: Yes.

Mr. BROWNE said that after the decision the existing companies would take no part in the discussion on clauses, as they felt it might affect their position in the other House.

(To be continued.)

Metropolitan Pneumatic Dispatch Co.'s Bill.

Tuesday, May 16th.

A SELECT Committee of the House of Commons, under the chairmanship of Sir Aubrey Fletcher, commenced the hearing of this Bill. Mr. Balfour Browne, K.C., and the Hon. F. D. Fitzgerald, K.C., appeared for the promoters, and there were a large number of petitioners against the Bill, represented by counsel, including several of the electric lighting companies, the Metropolitan Borough Councils, railway companies and others.

Mr. BALFOUR BROWNE, K.C., in opening the case, said the promoters sought to obtain power to establish a system within the administrative county of London for the pneumatic transmission of parcels, goods, and messages, to be worked by electricity, for which purpose they were asking powers to erect generating stations. The scheme was to lay down 95 miles of double 12-in. tubes. There would be 172 stations all over London, and the system they proposed to use was that known as the "Batchelor" system which had been in very successful existence in the United States for the last 12 years. It was protected as a system by 11 separate patents, all of which the company had purchased for the purposes of the scheme. Where it was carried out it was operated by electrical power, which was generated in the generating station. The electricity was conveyed by means of wires and conduits to various motors, which would operate the air compressors which would send the parcels through the tube in a carrier or shell. In order to carry out a great scheme like this it was necessary that there should be a large number of substantial people behind it. He was glad to say that the Bill was being promoted by a strong group of financiers, and he did not think there would be any question of the finance of the scheme. The amount of money involved in carrying it out was very large, but when he mentioned names of some of those who were supporting it, he did not think the Committee would have any doubt that the money could be easily obtained. Among those promoting the scheme were Messrs. Barclay, Bevan & Co., the bankers, Mr. Blaine, Chairman of the Standard Bank of South Africa, Messrs. Crompton, Messrs. A. Cayzer & Co., bankers, Messrs. Smith's and the Union Bank of London, Mr. Parr, of Parr's Bank, Messrs. F. Huth & Co., Mr. R. G. Martin, M.P., Mr. J. Pierpont Morgan, and a great number of others. If the scheme were entrusted to those capable hands, the Committee need have no fear but that it would be carried out. The capital of the company would be 4 millions. There were a great many protective clauses in the Bill—one for the Postmaster-General as to the routes of the tubes in the various streets, and another giving the local authorities under certain conditions the power to approve or disapprove of the routes, as the case might be. In the schedule of the Bill maximum charges were laid down. There was to be one charge for the collection, transmission and delivery of parcels or messages in the tube area, which was practically that of the Administrative County of London. Wherever the parcel was to be sent beyond the tube area, there was to be a totally different charge. All the stations would be laid out so that there would only be a half mile between each, so that messengers would not have to go more than a quarter of a mile. They proposed first to erect a great generating station for the power that was necessary to compress the air and to drive the motors, and it was calculated that they would require in the course of the year at least 10,000 H.P., or 30 millions of Board of Trade units. That was required at all the stations for operating the air compressors because, without the compression of air the parcels would not go through the tube. The rate of transmission through the tube was to be very rapid. They calculated that on the average the rate would be certainly 30 miles an hour, at which the shell containing the parcels or messages would pass from one place to another; if necessary that rate could be accelerated to 40, 45 or 50 miles per hour. The tubes were 12 in. in outside diameter, and were constructed so as to turn very sharp corners. The inside measurement of the tubes would be 10½ in. He would like the Committee to go over to Fulham if possible one day, where the system was actually in work on an experimental scale. Over-all, the enlarged end of the tube would be 17 in. The two tubes would be laid side by side with 18 in. between centres, and it would require a trench of 35 in. in which to lay the tubes and their electric connections. There was an ingenious time lock arrangement which obviated the risk of any carrier getting blocked in the tube, or any collision occurring, and the operation was done so quickly, and the rate of speed so high that the delay was infinitesimal—four or five seconds only being required between each carrier. To force the carrier through the tube they required an initial pressure of 10 lb. to the sq. in., but the tubes would bear 25 lb. to the sq in. Fragile goods, such as eggs and provisions, could be carried, as there was no oscillation. The carrier would be placed in the tube by a mechanical contrivance, and would then be transmitted by the compressed air. Each carrier was labelled with a disk, which disk came into contact with two electrical needles at any particular station, and by having a different sized disk for each station an ingenious selective system was arrived at. The working expenses of the company, it was estimated, would amount to £192,673 per annum. The tubes would cost £1,057,350, and an extra £1,201 had been included for excavation, owing to the work having to be done in a particular way to avoid breaking up the streets. The cost of the electrical apparatus would be £105,000; the plant at the station £805,580, and of the carriers £48,000. The total annual revenue, including parcels, newspaper delivery, and Post Office business was estimated at £935,912, which would be sufficient to pay 11·7 per cent. interest on the capital. Calculating the revenue without the Post Office business, the profits would be sufficient to pay 8·9 per cent. An attempt had been made in the House of Commons to put the Bill back pending the report of the Traffic Commission, but the chairman of that Commission had said that he saw no reason for that, as the scheme was not one affecting the traffic problem.

Mr. V. C. BATCHELOR, chief engineer to the Batchelor Pneumatic Tube Co, of Philadelphia and New York, replying to Mr. FITZGERALD, said he was the inventor of the system which was in use in one or two cities in America. Witness then explained the system in detail, and said it was quite a success in America.

In cross-examination by Mr. FOLLOCK, K.C., for the London County Council, WITNESS said that the largest system yet in operation in America was only about 4 miles long, with two or three stations. Although the system proposed in this Bill was much larger, the new methods of operating it made it even more simple to work than was the American system. The power was transmitted to each station, and transferred by each compressor to the next station, and a system of relays was made use of. The electric cables would be laid with the tubes, and manholes would be put in every 350 feet. A great deal of canvassing had been done to see what was the probable number of parcels, &c., the company would have to deal with, and it was upon those reports that their estimate of receipts had been made. The carriers would be despatched every 10 seconds, and as the rate of transmission would be uniform there would be no risk of collision.

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Wednesday, May 17th.

Sir RALPH LITTLER, K.C., read, on behalf of the City Corporation, a letter from the Postmaster-General in which it was stated that he thought the Bill ought to be suspended pending the report of the Royal Commission on London Traffic, and that he should oppose the Bill on third reading.

Mr. BATCHELOR gave further evidence as to the laying of mains and also as to the congestion which would be caused by 3,500 boys on tricycles delivering parcels. He felt that any such inconvenience would be outweighed by the great relief to the streets by the direct conveyance of parcels to the centres and thus doing away with delivery vans.

In re-examination, WITNESS said that the longest run on the carrier without rehandling in New York was about six miles.

Questioned by Members of the Committee, WITNESS said there had been no attempt to lay down any of these tubes for commercial purposes since 1898. In New York there was only one local authority to deal with as to the route of the pipes, and there was no friction.

Mr. EDGAR COHEN, a director of Harrod's Stores, and one of the promoters of the Bill, said that Harrod's dealt with 8,000,000 parcels in a year, and he had calculated that it would be a considerable saving to the Stores if they could use the pneumatic system as proposed. Further, it would be a great advantage to have a continuous despatch and delivery.

By Mr. POLLOCK (for the London County Council): Originally the Postmaster-General gave great encouragement to the scheme, but after the second reading of the Bill, this had suddenly changed to antagonism, and things had been done which had hitherto not been considered to be Parliamentary.

Mr. POLLOCK said that after such a remark he could not continue his questions. If any charge was to be made against the Postmaster-General, someone from that department had better be called.

The CHAIRMAN said he thought Mr. Pollock had better allow the matter to drop.

Replying to further questions, WITNESS said he did not think it was absolutely necessary for the company to erect a generating station of their own, but he did not wish to be at the mercy of the electric lighting companies or local authorities. They proposed to use the streets without any payment to the local authorities, but, of course, the system would be for the benefit of the shopkeepers in those streets, and the stations of the company would be rated and taxed.

In re-examination by Mr. LE BRETON, WITNESS said he had not anticipated that the Post Office would necessarily be a customer, but they would be prepared to deal with the Post Office.

The CHAIRMAN said it was right for him to warn the promoters when they put their engineers into the box that the Committee would require some very strong explanation defining the streets it was proposed to break up. He had sat in those rooms for 25 years, and he did not ever recollect gas, water, or electric lighting Bills where such *carte blanche* was given to any company as was asked for in this one. Some definition of the route must be given.

Mr. LE BRETON said they were following the elec ric power Bills exactly. There was more similarity between their scheme and electric power schemes than any other schemes.

Sir R. LITTLER, K.C., said the routes to be taken by electric power companies were shown in every Power Bill.

Mr. R. BURBRIDGE, managing director of Harrod's Stores, also gave evidence in favour of the scheme, and said that if the Post Office saw its way to take up the scheme they would get their letters and parcels quicker.

Sir R. LITTLER proceeded to cross-examine with reference to the delivery of the Metropolitan District Railway, and suggested that he should give a fair trial to that company.

The CHAIRMAN: Had you not better enter into your negotiations outside the room?

Mr. POLLOCK, K.C.: Are you aware that there are no fewer than 58 local authorities and undertakers who have power to break up the streets of London?

WITNESS: Then one more or less won't matter.

Mr. FRANK WHITELEY, director of Wm. Whiteley, Ltd., said his company delivered 3,000,000 parcels in the course of the year. 50 to 60 per cent. of these parcels could go through the tubes.

Other evidence of a similar character was called.

Thursday, May 18th.

The Hon. J. D. FITZGERALD, replying to a question by the Chairman, said that when the promoters considered the question of the taking up of the streets it was thought that it would be best to have that particular form of clause which had been drawn up for the Power Bills then under consideration. The clause enabled the local authority to object to a particular route.

Sir JOHN WOLFE BARRY was called in support of the promoters' case. He said that if the cut and cover method of construction were adopted there would be little interference with the street traffic. In the case of Westminster and the City, arrangements had been come to as to the hours during which the work should be carried on. The Stepney authorities had agreed to a route, and out of the twenty-nine metropolitan authorities only seven were, it would be observed, appearing against the Bill. Witness said that there would be no trouble in "getting across railways," as the tubes "could be laid in any position."

The Committee adjourned at an early hour, in order to pay a visit of inspection to the experimental line which has been laid down at Fulham, the CHAIRMAN remarking that they would wish to have the company of an engineer representing the local authorities. It was arranged that Mr. Maurice Fitzmaurice, the engineer to the L.C.C., should accompany the Committee, as well as the engineer to the promoters.

Friday, May 19th.

Mr. A. E. STEWART was called on behalf of the promoters. He put the total cost of a double line of tubes 95 miles in length, and having 172 stations, at £2,808,659. In reply to Mr. HONORATUS LLOYD, K.C., the witness would not admit that the tubes could not be used for fast and slow traffic. He further stated that although the question of giving the large stores private stations had been discussed, no definite promise of such stations had been made. Cross-examined by Mr. CLEESE (for Fulham and Shoreditch), Mr. STEWART said that it was proposed to despatch 600 "carriers" per hour. He admitted that with three men at a station, that would mean that each man would have to fill 200 carriers an hour. He thought that that would be quite possible, but said that it must be remembered that the traffic at all the stations would not necessitate the despatch of 600 carriers an hour.

Re-examined by Mr. BALFOUR BROWNE, K.C.: The figures with regard to the 600 carriers were merely put in to show the maximum capacity of a single 12 in. tube. London, he said, was *the* place of all places where such a system as that proposed should be installed. It would be even more valuable in London than in New York.

Monday, May 22nd.

On Monday, Mr. STEWART, replying to various questions by members of the Committee, said that a single tube would be capable of dealing with 144,000 copies of a four-page newspaper in half an hour, calculating 320 copies of the paper in each carrier. The witness thought that it would be quite possible to deal with the number of carriers which would be necessary.

Col. CROMPTON, Managing Director of Crompton & Co., was then called, and spoke to having been to America for the purpose of studying the question of pneumatic dispatch. He had inspected the Batchelor system at New York, Boston, and Philadelphia, and considered that it was quite suitable for London. When he saw the tubes they showed no signs of wear and were highly polished by the continuous passage of the carriers through them. He had been told by the postal authorities in New York that the tubes were absolutely reliable and safe, and that there had never been any damage caused to parcels or letters. There was some damage done to a few letters when the tubes were first used at Philadelphia, but it was due to one of the carriers coming open in transit, a thing which could not occur in the present type of carrier. When he was in New York the postal authorities showed him how the tube worked by sending a marked card to a certain point outside the city and back. The rate of travelling, including the time occupied by the taking out of the card, marking it, and dispatching it back to the point from which it was sent, was thirty miles an hour. He saw no engineering difficulties whatever in the scheme as proposed by the promoters, and he agreed with what the previous witnesses had said with regard to the amount of power required. As to the question of capacity, he could not see any difficulty at all: it was merely a question of having a sufficient number of carriers for the tubes. He had not gone into the details of the newspaper traffic, but he considered that it could easily be dealt with if there were a sufficient number of tubes leading out of the newspaper district. A four-way station could despatch 2,400 carriers in an hour. He thought that the percentage of carts which the introduction of the tubes would remove from the streets would be between 16 and 17 per cent. Witness put in the following tables showing the estimates of the cost of power if purchased from local authorities and if generated by the promoters themselves:—

TABULAR STATEMENT SHOWING COMPARATIVE COST OF POWER.

1. If purchased from Local Authorities at the proposed rate of 0·75 of a penny less a rebate of 1/100th of penny for each 1 per cent. that the load factor exceeds 50 per cent. At average load factor of 62 per cent. this equals 0·63 of a penny.

31,275,489 B.T.U. at 0·63d.	£82,091
Estimated repairs on distribution plant	4,500
Depreciation on ducts, conduits, and manholes at 2½ per cent., £2,100; Depreciation on power cables at 4 per cent., £4,200; Depreciation on telephone cables at 5 per cent., £762	7,062
Total annual cost of power if purchased	£93,653

2. Cost of Power if generated on the proposed Wood Lane, Shepherd's Bush, site by the Company itself.

Fuel, being 74,500 tons of Nottinghamshire Nuts at 11s. 6d. per ton ..	£42,837
Petty Stores	2,000
Wages and superintendence	4,503
Repairs to generating plant (estimated)	4,500
Repairs to distribution plant as above	4,500
Depreciation on buildings, tanks, and similar works	450
Depreciation on generating machinery generally at 10 per cent.	10,300
Depreciation on distributing machinery as detailed above	7,062
	£76,149

Witness said that the latter table was based on his own estimate; he had checked the figures of the first table. Continuing, witness said that when in New York he was informed that the tubes had been repaired only two or three times in the course of the nine years during which they had been in existence.

Sir RALPH LITTLER, K.C., cross-examined witness on behalf of the City and of the Metropolitan District Railway. Witness said that he had seen many of the openings in the City streets, and he did not think that the streets of the City were any more crowded with pipes than the streets in the West End.

Cross-examined by the Hon. EVAN CHARTERIS on the tables which he had put in, witness said that the number of units

required by the motors would not be so great as had first been thought. The figure of 31,000,000 units was a mistake. They would buy only 23,000,000 units if they took their supply from a local authority.

Mr. CHARTERIS explained to the Committee that the point was that if the company took their current from a local authority or a company they would only have to pay for what they used; whereas if they generated their own current, it would mean that they would have to generate a larger number of units than was actually required, so as to allow for wastage. It would bring the cost of generating at Wood Lane down to £66,000.

In reply to Mr. CLEESE, witness said that he was in America for two months; he knew that only twenty-seven miles of tube had been laid in America. Mr. Cleese put it to witness that if his scheme were a success, the taking off the streets of the carts, with the accompanying drivers and boys, would mean a great dislocation of the labour market in London.

Witness would not admit this: he thought they would employ as many as were thrown out of employment.

Witness having been re-examined, the CHAIRMAN asked if the promoters had ever thought of experimenting on a smaller scale.

Col. CROMPTON replied that the system would not be of any practical utility unless it was constructed on the scale proposed.

Tuesday, May 23rd.

Evidence was given in support of the scheme by local authorities and others, including Mr. Basil Ellis (John Aird & Sons), who spoke as to the engineering construction.

The L.C.C. Tramway Bill.

Thursday, May 18th.

THIS Bill came before Mr. Kearley's Committee of the House of Commons. Counsel for the promoters were Mr. Erskine Pollock, K.C.; Mr. Moon, K.C.; and Mr. Du Cane.

In opening the case, Mr. ERSKINE POLLOCK said at the present time there were 115 miles of tramways laid down, of which the L.C.C. owned 70 miles. All the tramways in this Bill were proposed to be worked by electricity on the conduit system. Tramway No. 1 was a line one mile four chains in length. It started from the terminus of the existing tramway in Westminster Bridge Road, and passed across the Bridge, and thence along the Embankment, terminating in the subway at Waterloo Bridge. The object of that tramway was to connect the northern and the southern systems. The tramway which it would join in the subway had already been sanctioned. Westminster Bridge had a width of 54 ft. 4 in., and was therefore a very wide road for two lines of tramways. Where the line turned round on to the Embankment, just opposite the St. Stephen's Club, the road had a width of 94 ft. The Embankment itself for most of its length had a width of roadway, apart from footpaths, of 64 ft., which was a very wide road indeed. When the tramway reached Waterloo Bridge it would turn into the subway, and a slight deviation had been found necessary. Tramway No. 1A was a very short bit, a bit connecting No. 1 with the tramways on the Albert Embankment. Here a widening of the roadway would be necessary, and for this purpose the authorities of St. Thomas's Hospital had agreed to sell them a small strip of land. Tramway No. 2 was a proposed line over Blackfriars Bridge. Blackfriars Bridge Road had a width of from 54 ft. 7 in. to 54 ft. 1 in., while the Bridge itself was 40 ft. 2 in. wide between the curbs. Starting from the existing tramway terminus, the line would cross the Bridge and turn down along the Embankment, terminating with a junction with the other proposed tramway on the Embankment. Where the tramway went along the Embankment there would be a width of 25 ft. on each side of the lines. Tramway No. 2A was merely a short loop to allow the trams coming out of the subway at Waterloo Bridge to turn eastwardly on to the Embankment. The first two tramways would cost £53,200, and the second two £52,700. Counsel then went into the history of the various schemes for getting the tramways over the bridges, and stated that as early as 1892 a Bill to authorise a horse tramway to be run by the L.C.C. over Westminster Bridge and along Whitehall as far as the Horse Guards Avenue was passed by a Committee of the House of Commons, although it was rejected by the House of Lords. Ten years later the subway scheme and the scheme for a tramway along the Embankment which should not cross the Bridge came before Mr. Hobhouse's Committee of the House of Commons. Dealing with the question of the opposition, Counsel remarked that there were certain "frontagers" along the Embankment who were opposing the Bill, but out of 179 there were only twenty-five or thirty who were really frontagers in the correct sense of the word.

At the conclusion of the learned Counsel's opening, the CHAIRMAN of the Committee said that the Committee would consult with the Home Secretary for the purpose of arranging for the attendance of a representative of the Home Office to give evidence as to the alleged obstruction which the trams would cause on the Embankment.

Mr. MAURICE FITZMAURICE, Engineer-in-Chief to the London County Council, was the first witness called. He corroborated the figures given in Counsel's opening statement. In the case of Westminster Bridge there would be 10 ft. between the two pairs of rails; allowing for the overhanging of the cars, there would be 8 ft. between two passing cars. He did not put that forward as an advantage; it was the best way to lay the lines. There would be 17 ft. 2 in. on each side of the outer rail.

In reply to the CHAIRMAN, witness explained that the Bridge was constructed with a number of steel ribs about 5 ft. apart, and the conduit had to be placed between those ribs. The distance apart of the two sets of rails could, if it were considered necessary, be decreased by 2 ft. 6 in. The distance apart from centre to centre of the track would, if their proposal was carried out, be 15 ft. The total cost of the four tramways was £106,400.

Mr. FREEMAN, K.C., cross-examined witness on behalf of the Metropolitan District Railway. The scheme, so far as the Embankment was concerned, did not differ from the scheme of 1902. It was the intention of the Council to run trams from, say, Peckham to Westminster, then across the Bridge, and by way of the subway to the north of London. They would have a through route. Only single-deck trams could pass through the subway. He did not suggest that there was any engineering difficulty in carrying the trams over the railway company's tunnel. If it was necessary to cut into the tunnel it could be done easily.

Friday, May 19th.

Mr. Fitzmaurice continued his evidence. Cross-examined by Sir RALPH LITTLER, K.C., witness could not say from memory which was the greater traffic at the northern end of Blackfriars Bridge—the west to east or the north to south. He had never known traffic to be held up for four or five minutes. He had not got the figures of the number of vehicles passing over the Bridge.

Sir RALPH suggested that the blocking of the traffic on the south side of the Bridge might be got over by having a "station terminus."

Witness said that the Council did not want a "station terminus." They wanted a circuit route.

In re-examination, Mr. FITZMAURICE repeated his statement that there would be no difficulty whatever in crossing the tunnels of the Metropolitan Railway Company.

Tuesday, May 23rd.

Evidence was given by Mr. Harper, statistical officer to the L.C.C.; Mr. J. R. Bruce, traffic manager to the L.C.C.

In reply to a question by Mr. MOON, the CHAIRMAN said it would be too big an enterprise to hear all the representatives of the 21 local authorities. The Committee understood that the local authorities supported the Bill.

(To be continued).

Second Reading.—**In the House of Lords on May 18th the following Bills were read a second time:—Ealing Corporation Bill, Halifax Corporation Bill, Stockport Corporation Bill, Bristol Corporation Bill, Croydon Corporation Bill, South Wales Electrical Power Distribution Co. Bill, Aberdare U.D.C. Bill, Colne Corporation Bill, and Swansea Corporation Bill.**

In the House of Lords on Monday, May 22nd, the following Bills were read a second time:—Baker Street and Waterloo Railway Bill, Edgware and Hampstead Railway Bill, and Charing Cross, Euston and Hampstead Railway Bill.

Third Reading.—**In the House of Lords on 19th inst. the Weybridge and Walton-upon-Thames Electric Supply Bill and the Chelsea Electricity Supply Bill were read the third time and passed. In the House of Commons on May 22nd, the following Bill was read a third time:—Tyneside Tramways and Tramroads Bill.**

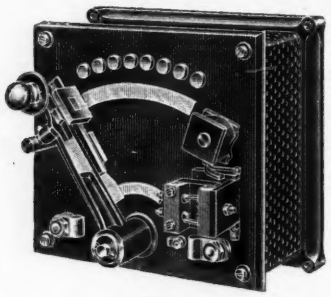
Electric Lighting Order Bills.—**On Thursday, May 18th, the Electric Lighting Confirmation Order Bills, Nos. 1, 2 and 3, came before the Unopposed Bill Committee of the House of Commons, and were ordered to be reported for third reading. The Bills confirm orders in Bury, Conway, Golborne, Haydock, Little Lever, Southall-Norwood, Spalding, Whitwood, Whitworth and Woolwich.**

Metropolitan Electric Tramways Bill.—**It is announced that all opposition to this Bill has been withdrawn, and the Bill is accordingly referred to the Committee on Unopposed Bills.**

Dublin United Tramways Bill.—**Mr. Tatterton-Egerton's Select Committee of the House of Commons on Friday commenced their consideration of the Bill promoted by the Dublin United Tramway Co., the object of which is to transfer the undertakings of the Dublin Western Tramway Co. and the Dublin Southern Tramway Co. to the Dublin United Tramway Co. Mr. Balfour Browne, K.C., the Hon. J. D. Fitzgerald, K.C., and Mr. Vesey Knox were counsel for the promoters. Amongst the opponents of the Bill were—the Dublin Corporation, the Pembroke U.D.C., and the Rathmines and Rathgar U.D.C. Mr. Balfour Browne, explaining the objects of the Bill, said that the transfer was not a difficult undertaking, inasmuch as practically all the shares of the companies were held by the Dublin United Co. Practically all the Bill did was to legalise by Parliamentary statute what had already been done by purchase. The opposition of the Corporation of Dublin was simply on the question of purchase. In the Bill it was proposed to erect a generating station at Ringsend. In an earlier Act the company had been authorised to erect a generating station upon another site to be agreed upon with the Corporation. The site at Ringsend had since been adopted, and the question arose whether, by the former Act, it would be purchasable by the local authority. Mr. Balfour Browne, in conclusion, referred to the transfer of the Walker and Wallsend Union Gas Co., which he said was somewhat similar to this case in regard to the position of the local authority. Mr. W. M. Murphy, the chairman of the promoting company, said that the lines would all become purchasable by the local authority in 40 years from 1897. On Tuesday the Committee passed the preamble inserting certain clauses to preserve the rights of the Rathmines local authority. Dublin Corporation reserved its opposition for the House of Lords.**

BUSINESS NOTES.

Motor-Starting Gear.—Messrs. Reyrolle & Co., Ltd., have for some time manufactured a reliable and efficient motor-starting switchgear of the drum type, of which a description has appeared in the ELECTRICAL REVIEW. They have now brought out a new starter of the lever type, as illustrated herewith. The figure shows one of the open type, with overload and no-voltage release. Another pattern is made in which the working parts are protected by a casing. All the starters are fitted with the Reyrolle patent



REYROLLE MOTOR STARTER.

resistance, which has given satisfactory results in connection with the drum-type starters, and it is claimed that the new gears, upon the design of which a great deal of labour has been expended, have the following advantages:—Fireproof construction, mechanical joints (without solder), high insulation resistance, small bulk, high overload capacity, and high-class workmanship. They are rated for starting the motors on full load. The Sunbeam Lamp Co., Ltd., of Gateshead, and of 102, Charing Cross Road, W.C., are sole selling agents for the Reyrolle manufactures, and will supply particulars and descriptive pamphlet on application.

Trolley Wheel Patent Lubricator.—A simple little device has been brought out by Mr. L. J. Bedford, car-shed superintendent of the Isle of Thanet Tramways and Lighting Co., for the lubrication of trolley wheels. It consists, as shown in the figure, of a hollow spindle with a screw plug at each end, one of which is movable, so that the spindle can be filled with oil. The lubrication is effected by the capillary action of a loosely fitting pin, which is inserted in a hole drilled in the under side of the spindle. The latter, which is made of case-hardened steel, is fixed firmly in

Long. Section.—A, Easy fitting pin; B and C, Screw plugs. Cross section at centre.

BEDFORD LUBRICATOR

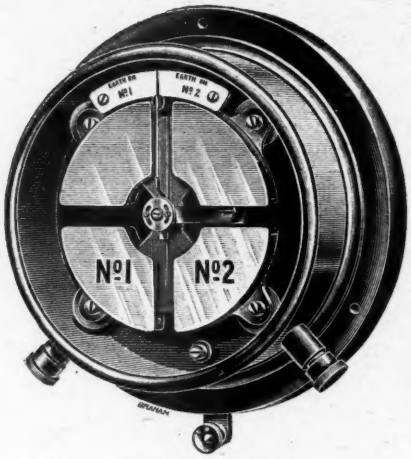
position in the forks, with the wheel threaded on, and is then ready for use. The advantages claimed for this spindle by the patentee are that it obviates the necessity of bushing the wheels, thus effecting a considerable saving, and that one charge of oil is sufficient for a fortnight's run; also that one spindle will outlive two dozen wheels, besides increasing their life. The above-named company has adopted lubricators of this type, and the results are very gratifying, as they have been in use for over four months, and as yet no sign of wear in the bore of the hubs of the wheels has been noticed, although the wear on their periphery has necessitated scrapping them. The same principle could obviously be applied to other purposes.

Howden Engine Contracts.—Messrs. James Howden and Co., of Glasgow, have recently booked the following orders:—

P. Dixon & Sons, Sheffield, one 900-B.H.P. compound engine.
Southend Corporation (per The Electric Construction Co.), one 600-B.H.P. triple-expansion engine.
Russell & Co.'s Shipyard, Port Glasgow (per Messrs. Mather & Platt), one 420-B.H.P. compound engine.
Guildford Electric Light Co., one 320-B.H.P. triple-expansion engine.
Hamilton, McCulloch & Co., Hamilton (per Messrs. Telford, Grier & Mackay), two 300-B.H.P. compound engines.
Nobel's Explosives Co., Stevenston (third repeat order) (per Messrs. Siemens Bros. & Co.), one 300-B.H.P. compound engine.
Cadzow Coal Co., Larkhall, two 225-B.H.P. compound engines and dynamos.
Cox Bros., Dundee (per Messrs. Mather & Platt), one 160-B.H.P. compound engine.
Loders & Nucoline, Ltd., Cairn Mills, Silvertown (per Siemens Bros. & Co.), one 60-B.H.P. compound engine.
Bedwellty Asylum (per Messrs. Edwards & Armstrong), two 38-B.H.P. compound engines.
Liverpool Daily Post, two 38-B.H.P. compound engines.

Belgium.—The balance-sheet of La Société des Accumulateurs Tudor, of Brussels, for the last financial year shows a profit of £3,790.

New Mining Regulations.—Messrs. Nalder Bros. and Thompson, Ltd., have brought out an electrostatic earth detector specially devised to meet the requirements of the Home Office, as expressed in the New Mining Regulations. These detectors, of which one is illustrated herewith, are of very simple construction. Each instrument is provided with three terminals, to be connected to the positive and negative mains respectively, and to earth. Should an earth occur on either main, the pointer is at once deflected to the corresponding side. In principle the instrument is simply a quadrant electrometer, with the needle earthed, and is suitable for any voltage from 300 volts upwards, D.C. or A.C. It can be adapted to three-phase circuits. Messrs. Nalder Bros. are also supplying an electromagnetic voltmeter wound to a very



NALDER BROS.' EARTH DETECTOR.

high resistance, so that insulation readings can be obtained on 300-volt circuits down to 0·5 megohm, and on 600-volt circuits to 1 megohm.

THE WALSALL ELECTRICAL CO., LTD., send us particulars of their "C. M. R." fault indicator, which they have designed to fulfil the requirements of the new rules. The indicator consists of a specially wound ohm-meter mounted in an iron case, with a relay, and the necessary terminals for connecting to the circuit. The whole is mounted on enamelled slate carried in a cast-iron frame.

C. M. R. FAULT INDICATOR.

When there is no fault on either of the mains, the pointer rests in the centre or zero position; should a fault develop on one of the mains, the pointer registers the amount of leakage and points to that side of the circuit on which it has developed.

Should the leakage exceed the limit specified by the Act, *i.e.*, $\frac{1}{1000}$th of the maximum supply current, the shutter on the relay will fall, and so attract the attendant's notice. Terminals are provided for attaching a bell, so that if desired the shutter will cause the bell to ring until the attendant has either cleared the fault or stopped the bell ringing.

Battery Contracts.—Messrs. Pritchetts & Gold, Ltd., have just booked the following contracts:—

Aldershot District Council.—260 complete renewal sections for central station battery.
Peterborough Corporation.—240 positive renewal sections for central station battery.
Abergavenny Asylum.—130—450 ampere-hour cells.
W. T. Henley's Telegraph Works Co., Ltd.—200 cells for their new works at Gravesend to work in conjunction with an automatic reversible booster for lighting and power purposes.
Burton and Ashby Light Railways (Midland Railway Co.).—260—1,310 ampere-hour cells in lead-lined boxes, to work with reversible booster on traction load.

The firm have been lately exporting a number of batteries to India, Japan and Australia, and are exceedingly busy just now.

Catalogues and Lists.—Messrs. Johnson & Phillips. Abbreviated price list (No. 13), giving tabulated data respecting their different classes of vulcanised rubber cables, also flexibles, electrolier wires, Manilla paper-insulated and lead-covered cables, house-wiring cables, &c. A number of pages are left at the end of this useful-sized list for contractors' notes.

W. T. Henley's Telegraph Works Co., Ltd. Part 2 of their price lists of paper-insulated cables. Part 1, comprising L.T. cables and H.T. C.C. cables, was published in January last. Part 2 is entirely devoted to three-phase H.T. and E.H.T. cables. It is divided into two sections, one detailing cables for use with "Delta" connected generators, and the other cables for use with "Star" connected generators. Both classes are shown for working pressures up to 2,200, 3,300, 6,600, and 11,000 volts respectively. Some boldly printed sectional views appear of cables supplied for Sydney lighting and tramways, Isle of Man tramways, London underground railways, and many other lighting and traction systems.

Messrs. E. P. Allam & Co., London, E.C. Circular (No. 17) illustrating and describing, and giving prices of, their premier open type motor-starters.

General Electric Co., Ltd., London. Illustrated circular relating to their English-made arc-lamp carbons and carbon battery plates.

Messrs. Holden & Brooke, Ltd., Manchester. A number of lists relating to their "Expulsor" steam pump, "Sirius" steam trap, the "P.S." valve, ejectors, water-lifters, or jet pumps.

Mr. C. Kressmann, Bopp-Strasse, 6, Berlin. Circular relating to his new house telephones, which he calls the Caristophones.

Messrs. Cobb, Soanes & Co., 2, Occupation Road, Manor Place, Walworth, S.E. Circular relating to their patent accumulator, which is stated to have a special grid for providing an efficient centre contact with the active material. This contact is to assist the plate to withstand rapid charging and discharging, and to prevent buckling or blistering. The battery is intended for automobile work, carriage lighting, hand lamp, X-ray, and other work.

Messrs. Johnson & Phillips, Old Charlton. French cable list, giving particulars in that language, and on the metric system, of their standard vulcanised rubber cables. Mr. Douglas Wells, M.I.E.E., Rue de la Pepinière, 10, Brussels, Belgium, is the agent for this firm's manufactures for Belgium, Holland, and the North of France.

British Prometheus Co., Ltd., 18, London Road, Kingston-on-Thames. New pamphlet (No. III.) describing and illustrating Prometheus electric heating and cooking utensils and convectors. The list is intended for private circulation by the electrical trade, and firms can print their own name on the cover. It includes the majority of the Co.'s best selling patterns of domestic apparatus, and several new patterns are shown, particularly the No. 70 milk steriliser and the No. 780 copper shaving pot. The British Prometheus Co. have recently opened a showroom at 27, Ely Place, Holborn Circus, E.C., where a representative show of samples is on view.

Berliner Telephone Manufacturing Co., London, E.C. An attractive 32-pp. pamphlet (No. 65) showing, pricing and briefly particularising their various lines of telephonic instruments for domestic and other purposes, patent convertible battery telephones, automatic battery reply and call instruments, magneto wall and table sets, intercommunication sets, both battery and magneto call, &c.

Messrs. R. W. Blackwell & Co., Ltd., City Road, E.C. This company is urging its friends to look out for "Our Stand" at the forthcoming Tramways Exhibition, which notice is attached to an imposing wall calendar, dating from June, 1905—May, 1906. A good stout paper is used, and the upper half of every sheet contains an illustrated description of the "I.T.E," circuit-breakers and other specialities.

The Frictionless Engine Packing Co., Ltd., Harpurhey, Manchester. New catalogue of "Karmal" engine packings, "Reko" belts, "Fepco" lubricant, and other specialities.

Messrs. Ernest F. Moy, Ltd., Camden Town. Sheet detailing type No. 18 combined switch and circuit-breaker.

Bankruptcy Proceedings.—Alex. John Noble.—An application for an order of discharge was made on May 19th to Mr. Registrar Brougham on behalf of A. J. Noble, electrical engineer, lately carrying on business at 567, Battersea Park Road, S.W. Mr. G. W. Chapman, Official Receiver, reported that the failure occurred in June, 1903. The liabilities amounted to £266 13s., and a sum of only 15s. was realised in respect of the estate. The bankrupt began business at Howard's Road, Plaistow, in August, 1900. In September, 1901, he and his father and brother, whom he had verbally agreed to take into partnership, purchased for £230, payable by instalments, an electrical engineer's business at 567, Battersea Park Road. His father and brother were not entitled to draw money or interfere in the trading until their capital amounted to £100 each, and the bankrupt alone continued this business, as well as that at Howard's Road, in the name of A. J. Noble & Co. On March 5th, 1902, as there was little or nothing doing at Battersea Park Road, the premises were closed, and the stock removed and sold by auction, realising about £32, which was paid to the creditors, and in the following month the business at Howard's Road and the bankrupt's furniture, were also sold, the proceeds, £45, being used to pay debts. This business was subsequently continued by the purchaser at Katherine Road, East Ham, under the management of the bankrupt. The failure was attributed to loss in connection with the business at Battersea Park Road, the character of which was, the bankrupt alleged, misrepresented to him when he bought it. The greater part of his indebtedness was in respect of the unpaid purchase-money of this business. Sufficient books of account were kept for the trading and appeared to have been balanced every three months down to January, 1902. The only offence alleged by the Official Receiver was insufficiency of assets to pay 10s. in the £ to the creditors, and on that ground the learned Registrar imposed a suspension of two years. Order entered accordingly.

H. J. Salter.—The first meeting of creditors was held on Monday at the London Bankruptcy Court under the failure of Harry John Salter, electrical engineer, lately trading in co-partnership at 235, High Holborn, with Harry Thorpe as Thorpe & Salter. Mr. Walter Boyle, Assistant Receiver, reported that the debtor had stated that he joined Mr. Thorpe in business in November, 1896, and they traded together until April 12th last, when they sold the business to the New Century Lock and Engineering Co., Ltd., for £495 in shares, of which the debtor received £133 preference and £47 ordinary shares. He became managing director of the company jointly with Mr. Thorpe. The only fresh capital put into the company was £5 by the signatories. Mr. J. M. Maskelyne had advanced the partnership £400, and was pressing for payment. The company was accordingly formed in his interest, and the vendor's shares, with that gentleman's solicitor, as security for the debt. The company did not take over the partnership liabilities, which amounted to £725. This debtor apparently owed nothing else, and had only had a few tools in the shape of assets. He attributes his failure to loss on the partnership trading. The Chairman added that Mr. Thorpe was also in Court, and an application had gone forward for the two sets of proceedings to be consolidated. No offer was submitted by the debtor, and the case was left in the hands of the Official Receiver to be wound up in the ordinary course of bankruptcy, the debtor's public examination being fixed for June 20th.

Robert Foster.—At Burnley, on May 18th, Robert Foster, electrical engineer, applied for the variation of an order of discharge made on February 16th last. The discharge was suspended for three years, or, as an alternative, immediately on debtor consenting to judgement for £250 payable by £50 every half-year. It was stated that the debtor was unable to take advantage of the alternative in February, but having been promised the post of chief engineer at Aston Manor Electricity Works at £300 a year if he obtained his discharge, the Judge was asked to vary the order, as he would be able to consent to judgement. As the Deputy Judge was sitting, the application was deferred in order that Judge Bompas, who knows the facts of the case, might deal with the matter.

H. Thorpe.—The case of Harry Thorpe, electrician and engineer, late of 235, High Holborn, and St. George's Works, Eden Grove, Holloway, came before Mr. Registrar Linklater, on May 16th, at the London Bankruptcy Court. The debtor commenced business in 1879, and he was joined in partnership in 1896 by Mr. H. J. Salter. The business was converted in April, 1904, into a limited company, which took over the assets but not the liabilities. One of the creditors subsequently sued the debtor, and obtained a committal order against him. His wife paid the debt, but other creditors pressed, and eventually he filed his petition. The accounts filed by the debtor show liabilities £728 0s. 1d., and assets £187 6s. 3d. Mr. Walter Boyle, Assistant-Receiver, reported that a receiving order had been made against Mr. Salter, and an application was going forward to consolidate the two proceedings. His Honour ordered the hearing to stand over until June 20th, the date fixed for Mr. Salter's public examination.

Alexander Holland (Electrical and Mechanical Engineering Co.), electrical engineer, Farnworth.—Receiving order made May 17th, on a creditor's petition. Date of first meeting, May 31st, and of public examination, June 21st, both at Bolton.

Receiver Appointed.—A receiver and manager has been appointed on behalf of the debenture-holders in the Carl Oppermann Electric Carriage Co., Ltd.

Car-Building Amalgamation.—The directors of the Electric Railway and Tramway Carriage Works, of Preston, met on 18th inst. to consider the proposal, mentioned in our last issue, for the purchase of the Castle Car Works, Hadley, and the British Electric Car Works, Old Trafford. Mr. G. Richardson presided, and, in the course of his remarks, said that owing to the keen competition the price obtainable for the cars was very low, but now the price would rise to a remunerative scale. In 1901, which was a great year for cars, the number made was 701; in June, 1902, it dropped to 507, due undoubtedly to competition; and in June, 1903, it fell to 456. However, this year they had had 565 cars to turn out. It was resolved that the two works be bought for the sum of £85,000, inclusive of £20,000 profit from the Metropolitan Amalgamated Railway Carriage and Waggon Co., Ltd., Birmingham.

Shade Ring Grip.

Shade Ring Grip.—Messrs. Millington and Everitt, of 18, King's Parade, Cambridge, have sent us a sample of their patent tool for removing and fixing shade rings on lampholders. The illustration herewith shows the arrangement of the device. The ring is gripped between the jaws by turning the thumb-nut at the base of the handle. The necessity for such a tool arises out of the growing difficulty in fixing shades of the artistic and varied shapes nowadays employed, some of which have very narrow necks, and the gripper here shown ought to fill this want very satisfactorily.

Destructor Test.—At the Woolwich Electricity Works a 24 hours' test of the destructor plant has been carried out by the National Boiler Insurance Co., during which time the boiler heated by the destructor gases carried the whole load of the station. The destructor was built in 1902 by Messrs. Meldrum Bros., Ltd., and is of their front feed regenerative Simplex type, having a continuous grate measuring 20 ft. × 5 ft., with four closed ashpits supplied with hot air under pressure, and four firing doors. Between the furnace and the boiler there is a secondary combustion chamber. The boiler is of the Babcock & Wilcox type, with superheater, and there is a regenerator heated by the waste gases, and raising the temperature of the air supply to nearly 400° F. A Green economiser is also fitted. Only three of the four sections of the grate were used during the test, the supply of refuse being insufficient to run them all. The principal results were as follows:—Total refuse destroyed, 63¼ tons in 24·4 hours. Evaporation (from and at) 1·917 lb. per lb. Weight of clinker and ash, 0·91 ton. CO_2 in flue gases, 9·8 per cent. Average temperature in combustion chamber, 2,125° F.; maximum temperature, 2,400° F. Temperature of outside air, 44° F. Temperature of forced draught, 392° F. Pressure in ashpit, 2 in. of water. Draught at base of chimney, 3 in. Temperature of feed water, 241° F. Steam pressure, 195 lb. gauge. Superheat, 117°. Electrical output per ton of refuse, 57·2 units, at an average rate of 148·2 units per hour. Only a portion of the gases passed through the economiser, and as the electrical load was not always sufficient to utilise the whole output from the boilers, large quantities of steam were almost continually blowing off at the safety valves during the test. The guarantee for the destructor was 40 to 50 tons per 24 hours, and this was greatly exceeded, with only three-quarters of the grate in use. The guaranteed evaporation was 1¼ lb. per lb. of refuse, as compared with 1·917 lb. obtained.

Metallic Shield Blow-out Controllers.—A very complete and well got-up pamphlet on their patent controllers has been produced by Messrs. Dick, Kerr & Co., Ltd. These controllers are all fitted with the ingenious arrangement for blowing out the arc on breaking circuit which forms the characteristic feature of the Dick, Kerr type, and they are designed for electric tramways, railways, or cranes. The blow-out device has been found to act with perfect success, and possesses, amongst other features, the advantage that its coils are in circuit only when required, not continuously, as when electro-magnets are used; moreover, its effect is proportional to the current flowing, without limitation due to the saturation of an iron core. The copper rings with which the coils are surrounded sustain no damage from arcing, and it is stated that, in 2,000 controllers thus equipped, not one blow-out has failed either on the copper shield or on the insulating partitions. The blow-out solenoids are mounted on a hinged frame, and can be swung out of the way, *en bloc*, the connection with the trolley wire being broken in the act of so doing, so as to render the interior of the controller safe to handle.

The braking arrangements adopted in these controllers are of special interest. In applying the rheostatic brake, Messrs. Dick, Kerr & Co. have contrived to arrange that several of the brake notches coincide with power notches, thus materially reducing the total number of notches, and allowing of satisfactory design in other respects without increasing the size of the controller. In passing from power to brake, instead of reversing the motor leads in order to convert them into generators, the motors are thrown into parallel with the armature leading the field in one case, and the field leading the armature in the other. A connection is then made between the two motors, between their respective armatures and fields, and the braking is regulated by resistance placed in circuit with this connection. The latter also acts as an equaliser, and only two additional contacts are required, instead of 10 that would otherwise be necessary were this ingenious device not employed.

A special arrangement is used in some of the controllers (D.B. 1 form E), whereby the motors are short-circuited when the controller is in the "off" position; this ensures that the car shall not be able to run back when stopping on an up grade, except at a very slow pace indeed. Controllers for two and four motor equipments, including 4 × 100-h.p. motors for railway working, are described. On the L. & Y. Railway the controller is double, each half controlling four motors of 150 h.p. each, with one handle, yet the controller is very compact. Neat little controllers have also been devised for cranes, stationary motors and electric locomotives.

Cheap Locks.—A correspondent wishes to know the name of the makers of a cheap latch lock suitable for transformer houses; latchkey to open all locks.

Book Notices.—*The Metric System.* By J. H. Van Biene. London: The Decimal Association. 1905. Price 3d. This is a reply to the late Mr. Herbert Spencer, a fierce opponent of the metric system, and is lightly written, avoiding dullness on the one hand and frivolity on the other. Mr. Van Biene's arguments are trenchant and convincing, showing up the inconsistencies in the statements of the supporters of our archaic chaos of units and measures. Besides this pamphlet, the Decimal Association is issuing a chart showing the whole of the metric system (price 1s.), and a metric card giving the principal units at a glance (price 1d.) While in general agreement with the policy of the association, we cannot see the necessity for the adoption of American spelling for the names of the units, seeing that it is etymologically incorrect, and contrary to the usage already established in this country. If "litre" is to become "liter," why should not "meter" be further changed to "mitre"? Or, if phonetic spelling is to be introduced, why not "leetur" and "meetur"? In putting forward its ideas on spelling, the association has abandoned its proper *métier*; but fortunately there is no prospect of the mangled spelling being adopted.

The Telegraphist's Guide to the Departmental and City and Guilds Examinations in Telegraphy. By James Bell and S. Wilson. Fifth edition. London: S. Rentell & Co. The continual increase in staff which takes place in the engineering branch of the Postal Telegraph Service, and the requirement of higher qualifications in cases of promotions in, or indeed of entry into, the engineering branch, have necessitated ready means of obtaining theoretical information on the various subjects dealt with. Hence the demand for books of the useful class of which Messrs. Bell & Wilson's is one. Up-to-dateness has been aimed at, but not always with success; thus it is stated that the extra matter includes a description of the Wheatstone A.B.C. instrument, but this description shows a very ancient and entirely obsolete form of indicator, and the standard form is only briefly alluded to, and that in a misleading way. More detailed references are given to batteries and accumulators, but we think that the description of the old form of standard Daniell cell for testing might have been ousted, as it is now entirely obsolete. In fact, a little more care in omitting obsolete matter and replacing it with new, would be an advantage. The book, however, is well worth its sale price.

"Fire Tests with Partitions." Nos. 92 and 93. A 2½-in. and a 2¾-in. partition formed with Mantada partition slabs, fixed by the Adamant Co., Ltd., London and Birmingham. London: The British Fire Prevention Committee. 2s. 6d. each.

"The Engineering Press Monthly Index Review." Vol. V., No. 6. March, 1905. Brussels: Association de la Presse Technique, 1, Rue du Musée. 2.50 fr.

"Charter, Bye-laws and List of Members of the Canadian Society of Civil Engineers, 1905," and "Report of Annual Meeting." Montreal: The Society, 877, Dorchester Street.

"Fortschritte des Elektrotechnik," 1904. III. Berlin: Julius Springer. M. 7.

"Atti della Associazione Elettrotecnica Italiana." Vol. IX. Supplement to Part I. Rome: The Association, 397, Corso Umberto I. 1905.

"Annuals." By T. W. Sanders, F.L.S., &c. London: Agricultural and Horticultural Association. Price 1d. This neatly-printed pamphlet is No. 2 of the "One and All" garden books, edited by E. O. Greening, F.R.H.S. The series consists of practical articles by eminent experts, each handbook dealing with a distinct subject, and those of our readers who are interested in floriculture will find them full of interest.

"British Standard Specification for Structural Steel for Shipbuilding." Second issue, revised. London: Crosby Lockwood and Son. May, 1905. Price 2s. 6d. net.

Messrs. Crosby Lockwood & Son will be publishing shortly a work on "Modern Lightning Conductors," by Mr. Killingworth Hedges.

The British Empire Motor Trades Alliance.—It is announced that the Hon. C. S. Rolls (Messrs. C. S. Rolls & Co.) and Charles Jarrott, Esq. (Messrs. Jarrott & Letts, Ltd.), have tendered their resignations as members of the British Empire Motor Trades Alliance. Whilst they strongly sympathise with the objects of the Alliance, they consider that their trade interests at the present moment do not justify their continuing as members, but they hope, at an early date, to increase their British interests sufficiently to allow them to rejoin and become active members. For the same reason, Mr. Claude Johnson, to whose initiative the Alliance owes its formation, has tendered his resignation as honorary secretary.

Brush Contracts.—The following contracts have been placed with the Brush Electrical Engineering Co.:—

50-kw. steam dynamo set, for the Leicester Corporation.

Two 1,000-kw. steam turbo-alternators, for the North Metropolitan E.P.D. Co., for Willesden.

Four tramcars, with radial trucks, for Derby Corporation.

Five double-deck four-wheel car-bodies, with Brush standard trucks, for the British Thomson-Houston Co., for Lanarkshire Tramways.

Holiday Literature.—The London and South-Western Railway Co. have issued the "Official Illustrated Guide and List of Hotels, Apartments, &c., for 1905." This includes an excellent map of the south-western counties, the Channel Islands, and the north-west of France, an illustrated *Gazetteer* of the numerous watering places and holiday resorts in these regions, and abundant particulars relating thereto. With such an excellent guide before us, it seems really easier to go away for a holiday than to stay at home, and as the guide (of which 50,000 copies have been issued) can be obtained gratis from the superintendent of the line, Waterloo Station, or from the company's agents, and from Smith's bookstalls for 1d., there is no excuse for being without a copy.

Fire.—A serious fire occurred on Thursday, May 18th, at the works of Messrs. Sotheby & Co., 12, Carey Street, Westminster. This will in no way interfere with the foundry, smiths or brass-finishing departments, and Messrs. Sotheby & Co. hope to have all departments in thorough working order as before in the course of the next few days.

For Sale.—The General Post Office invites offers for the purchase of old stores which are briefly mentioned in our advertisement pages to-day.

At Ipswich on June 8th, Messrs. Garrod-Turner & Son will sell the stock of an electrical and motor engineer by auction. See our advertisements to-day.

Sawing Machines.—Messrs. Edward G. Herbert, Ltd., of Manchester, have recently received orders for their eccentric sawing machines from the Admiralty for Malta, and the War Office for Woolwich Arsenal. Eight of these tools have now been supplied to H.M. Dockyard at Malta, and they are also in use at eight other of H.M. Dockyards.

Trade Announcements.—Messrs. Adam Clarke & Co. have opened an additional factory at Coventry Road, Birmingham, for the manufacture of electroliers, pendants, brackets, standards, lanterns, ball, spider and ceiling fittings, and Mr. Archibald Campbell, of 27, Chancery Lane, W.C., has been appointed their London agent. We understand that they strictly confine themselves to wholesale houses.

Mr. W. Osborne Andrews has opened premises at 27, New Bailey Street, Salford, as a general stores for the supply of electrical and mechanical goods.

The Clift Manufacturing Co., of Bravington Works, Harrow Road, W., was on May 1st formed into a limited liability company, Mr. Mansell, late of Messrs. S. Z. Ferranti, having joined the company as managing director.

Mr. Robert Stotesbury, Bristol agent for the Unbreakable Pulley and Mill-Gearing Co., Ltd., has removed to more commodious premises in Temple Buildings, Victoria Street, Bristol, where he holds large stocks of the company's various specialities.

British Standard Pipe Flanges.—Messrs. Joseph Sankey & Sons, Ltd., of Bilston, notify that the Engineering Standards Committee have authorised them to manufacture templates in accordance with the sizes recommended in their recently-issued report, and at the prices fixed by the Committee.

LIGHTING AND POWER NOTES.

Ashton-under-Lyne.—The B. of G. on May 18th decided to have the electric light installed in the new hospitals and the old workhouse, at an estimated cost of £3,162, under the supervision of Dr. W. G. Rhodes, of Manchester, and a loan of £5,000 is to be applied for, this including £1,000 for wiring the workhouse. It is estimated that energy will be generated at a cost of ⅝d. per unit.

Birkenhead.—The report of the Corporation electrical supply department for the year ending March 31st last, has just been issued. Below we give the principal items:—

	1905.	1904.
Revenue	£12,678	£11,158
Total working costs	4,728	4,373
Result after providing for interest and sinking fund	2,109	1,386
Equivalent 8-c.p. lamps connected	66,574	50,353
Units sold	759,421	661,171
Capacity of plant	1,375 kw.	1,050 kw

Bradford.—The electrical engineer to the Corporation has presented a further report on the work which, in his opinion, is necessary to bring the electric supply system up to date. The sum of £40,000 has already been voted for new mains and the introduction of a polyphase system, and an additional £37,000 is now required. The annual capital cost of the new extensions he estimates at £2,875, and the annual saving by the conversion of the system, at £1,472. The cable expenditure has been £180,000, the distributing network covering 96 miles in length, but owing to the drop in pressure in the feeders, the engineer suggests in detail a number of new feeders and the points where they should be led into the system. It is proposed to borrow £60,000 for this and future mains extensions.

Briton Ferry.—On May 18th a L.G.B. inquiry was held relative to the application of the U.D.C. for a loan of £3,534 for E.L. purposes. The Council has arranged to take energy in bulk from the South Wales Electrical Power Distribution Co. for a period of 30 years, determinable at the end of each five years. There was no opposition.

Bury (Lancs.).—The Corporation Electricity Committee reports that the net profit made by the undertaking last year amounts to £2,932. Of this, £1,589 has been allocated to the relief of the rates, and £1,342 carried to depreciation and reserve fund.

Camp Lighting.—The Royal Bucks Hussars, I.Y., who commenced their annual 17 days' training at Stowe Park, Buckingham, on the 9th inst., decided this year to adopt a more up-to-date system of illuminating their camp, than the method of oil lamps and candles usually adopted. To this end, Messrs. Gillies and Hornidge, of the Buckingham Electric Light Co., and Queen Victoria Street, E.C., received instructions about a week before the regiment assembled to carry out the necessary arrangements for lighting the camp electrically, which, as the position chosen is some 2½ miles from the supply company's mains, involved sending out a portable plant to the encampment. Each of the 24 officers' bell tents was supplied with a single pendant light with switch fixed on the tent pole, the marquees used for officers' mess and ante-rooms and the sergeants' mess tent being lighted by clusters of three lights with single light pendants round the sides. For some of the larger-sized tents, such as the canteen, both arcs and incandescent lamps were employed. The parade ground facing the officers' lines was effectively lit up by Messrs. Veritys' "Aston-Worsley" arc lamps.

Chester-le-Street.—The R.D.C. has given its consent for an application to be made to the B. of T. by the County of Durham Electrical Power Distribution Co. to carry distributing lines overhead, instead of underground. In return for this the company undertakes to only charge 3¾d. per unit, less 5 per cent., for the supply of electric lighting.

The Clyde.—Messrs. William Beardmore & Co.'s new shipbuilding yard at Dalmuir, near Glasgow, where the keel has just been laid of the new battleship *Agamemnon*, has only lately been opened, and in fitting it out steam has been entirely dispensed with. A producer gas plant has been put down, and gas engines, made by the company, drive the Vickers generators providing power for the motors, machine tools, cranes, &c. The smith and forging hammers are operated by air. The producers also provide gas for the furnaces.

Continental Notes.—The old dispute between the municipal authorities of Vienna and the electric lighting companies—the International Electricity Co. and the General Austrian Electricity Co.—has broken out afresh, owing to the jealousy of the former as a rival electric lighting undertaker, combined with its general opposition to private enterprise. On the present occasion the Vienna Burgomaster has given the International Co. 24 hours' notice to remove from the ground, in municipal streets, pipes which convey condensing water from the Danube to the company's station, without entering into the question of the powers which the municipal authorities may, or may not, possess in regard to the enforcement of such a measure. Several negotiations for the municipalisation of the companies' undertakings have, in the past, been opened up, but these have not led to any result. The town finds that the private systems offer unpleasant competition to its works, and hence every endeavour has been put forth to remove it. A patched-up peace was made two years ago, on the basis that for a number of years the companies should renounce the extension of their mains and the acquisition of new customers. But even this serious limitation in activity is not satisfactory to the local authorities. The latest example of municipal warfare, it is considered, is calculated to make the International Co. more disposed to accept the recent offer made by the authorities, which represents over £100,000 less than the company requires for the purchase of its undertaking, and which the company declined a fortnight ago. The municipal authorities have also established a glow lamp factory, and threaten to compete with the International Glow Lamp Syndicate.

Italy.—A concession has been granted for the erection of a plant to utilise the water power of the River Trobiolo at Borno, in the generation of electrical energy, to be used for the reduction of iron-ore by the Stassano process. The municipal authorities of Nocera Umbra have just called for tenders for the electric lighting of the town.

Germany.—The municipal authorities of Allenstein have decided on the establishment of an electric lighting works in the town at an estimated cost of £19,600. Water power is to be utilised.

Spain.—A hydro-electric plant is to be erected on the River Urumea at Goizueta, Navarra, to supply energy for lighting and power.

Croydon.—The T.C. has decided to install an electrical pumping plant at the South Norwood Sewage Farm, in place of the Dowson gas plant.

Ebbw Vale.—On May 17th, a L.G.B. inquiry was held into the application of the U.D.C. for a loan of £9,654, for the establishment of a scheme of electric lighting. It was explained that the Council proposed to obtain energy in bulk from the Ebbw Vale Steel, Iron and Coal Co. at 1¾d. per B. of T. unit, the agreement being for five years. There was no opposition.

Electric Power in Scotland.—The Scottish Mineral Oil Works are adopting electric power. At Pumpherston the newly-installed electrical plant has run up a capital outlay of £17,204. The Philpstoun Works belonging to James Ross & Co. are to put down an installation, and at present the power house is in course of erection.

Elland.—The D.C. has reduced the price of electricity for power purposes, to consumers using more than 10,000 units per annum, to 1½d. per unit.

Greenock.—Negotiations between the T.C. and the Tramway Co. in regard to terms for a supply of electricity for the next five years from Whitsunday, have been brought to a satisfactory conclusion. According to the agreement, the company guarantees a minimum annual consumption of 500,000 units.

Heckmondwike.—The accounts of the electricity undertaking for the past year show a net profit of £1,154, against £260 last year. The whole of the surplus will go to the contingency fund.

Hove.—The E.L. Committee has been authorised to take steps under the agreement of 1892, to obtain an alteration in the charges made by the Hove Electric Lighting Co.

Hoylake.—The L.G.B. has written to the U.D.C., stating that it has no authority to sanction the borrowing of money for the provision of working capital for the purposes of the electricity undertaking.

Ipswich.—From Mr. F. Ayton, engineer and manager to the Corporation electric supply and tramways departments, we have received copies of a series of pamphlets which he is issuing to consumers and others who contemplate taking a supply of energy. They set out in an interesting and comprehensive manner the measures that should be adopted to obtain the best possible efficiency in the application of electricity to lighting and power. The various types of lamps are described, and tables of costs and efficiency are given. Electricity as applied to power purposes is dealt with, as are also window lighting and the question of health. The issuing of these leaflets, &c., to consumers from time to time, is a step in the right direction, and should be followed by all supply authorities.

Jarrow.—At the Jarrow Police Court on 18th inst., the County of Durham Electric Power Distribution Co. was summoned, at the instance of the Corporation, for allowing black smoke to be emitted from its power station chimney. The company denied that there was any nuisance, but said that such smoke as was emitted from the chimney would soon be altogether stopped. The company had entered into an arrangement whereby the electricity required for the town would be generated at the other side of the river, and the power station would in future be used only as a transformer station. When that was carried out, there would be no more smoke created there. The magistrates were of opinion that the offence was proved, and made an order for the nuisance to be abated within two months. If the order were not complied with, a daily penalty would be imposed.

Llanelly.—A special meeting of the U.D.C. was held on Monday to consider the E.L. question, and it was decided to take energy from the South Wales Power Co. and to lay its own distributing mains at an estimated cost of £6,000.

London.—The Metropolitan Area.—On Friday last week, representatives of the City Corporation, the Metropolitan B.Cs. and the Metropolitan Paving Committee met in conference at the Westminster Town Hall for the purpose of considering the question of the interference with the public streets by E.L. and other companies, and also by the Telegraph Department. A motion was adopted in favour of a Bill being introduced by the Government for the better protection of the local authorities as representing traders and the public generally. It was further decided to ask the Prime Minister and the President of the L.G.B. to receive a deputation on the subject.

Hackney.—The British Westinghouse Co. has completed the contract for the 1,500 kw. generating set, but the contract price of £11,831 has been exceeded by £52 owing to the provision of auxiliary oil pumps, &c. The Baths Committee announces that it will not be possible to let the baths building from October 23rd to November 11th for the Electrical Exhibition, but it may be had for three weeks from October 5th.

Fulham.—An agreement has been entered into between the B.C. and the promoters of the Pneumatic Dispatch Bill, under which the former is to supply it with energy for power purposes within the borough at a cost of ¾d. per unit on a minimum load factor of 50 per cent., providing that, if the load factor shall at any time be less than 50 per cent., then the ¾d. per unit is to be increased 1 per cent. for every 1 per cent. decrease in such load factor below 50 per cent. Under the scale of charges recently adopted for energy for private lighting, reductions were only made when the amount of the annual Bill exceeded £2. Objection has been raised to this, and the B.C. has resolved to abolish the minimum and to give all consumers the benefit of the reduction.

Woolwich.—The L.C.C. has sanctioned the balance of a loan of £15,000 applied for by the B.C., the balance amounting to £6,500, which is to be utilised in extending the mains into the districts of Shooter's Hill and Eltham.

St. Pancras.—In connection with the recent action of Colwell and Others v the B.C., £1,700 has been expended on behalf of the E.L. undertaking.

Kensington.—The B.C. on Tuesday, sanctioned main extensions by the Brompton and Kensington Electricity Supply Co., Ltd., in two roads and by the Notting Hill Electric Lighting Co. in six roads.

West Ham.—An application by Messrs. Johnson & Phillips to supply arc lamps on the hire-purchase system, on the same terms as agreed with the Electrical Co. and the General Electric Co. has been acceded to, by the Corporation.

Marylebone.—The Finance Committee of the B.C. has made application to the L.C.C. for advances, from the sanctioned loan of £493,800, to the extent of £50,000 in June, and £100,000 in July next, for the E.L. undertaking.

It was reported that the books of the Metropolitan Electric Supply Co. showed that during the year the total number of consumers was 5,801, and the gross income, including £4,470 from meter rents, was £137,840; the total units sold amounted to 6,289,877; and the average price obtained was 5·259d. When it has sufficient data available, the Committee proposes to consider a revision of the charges for energy.

New Zealand.—The Fire Underwriters' Association of New Zealand has adopted the Institution of Electrical Engineers' rules for electric light installations, which are now in force throughout the Colony. Much discussion has occurred in the New Zealand Press on this subject; some of the Colony's engineers still adhering to the Phœnix rules, on the plea that they tend to better workmanship.

Auckland.—The City Council has invited competitive designs for an electrical plant, to utilise the steam raised by its destructor.

Otago.—Mr. Mason, the engineer to the Harbour Board, has recommended that the present cranes be discarded and that electrical ones be obtained to replace them. The estimated cost of the new cranes proposed to be erected is:—A 12-ton gantry electrical crane, together with track, £4,200; three 3-ton cranes at £1,300 each; total, £8,100.

Prestwich.—A L.G.B. inquiry was held recently, relative to the application of Salford T.C. for a loan of £600 for the extension of the lighting mains to Prestwich. There was no opposition.

Penrith.—At a meeting of the U.D.C. on the 17th inst., it was stated that the National Electric Construction Co. had offered to take over the electric lighting powers of the Council on favourable terms. The Council decided to lease the powers to a company, and to solicit offers.

Rugby.—The U.D.C. has decided to apply to the L.G.B. for sanction to borrow a further sum of £2,000 for extensions. The Council's expenditure to date amounts to £12,262.

St. Andrews.—The electrical installation in this city is approaching completion. The generating station, which is situated in the Southfield district, contains two Babcock & Wilcox boilers, each capable of evaporating approx. 6,000 lb. of water per hour, with feed water supplied through heaters, in which the engine exhausts are utilised. Each boiler is equipped with a chain grate stoker, superheater, and an independent steel chimney 80 ft. in height. In the engine room there are installed a Reavell-Crompton generating set of 77-h.p. capacity, with a speed of 560 r.p.m., the dynamo having an output of 104 amperes at 450 to 480 volts; and a Belliss-Crompton set of 170 h.p., with a speed of 450 r.p.m., this generator having an output of 250 amperes, at 450—480 volts. A switchboard, booster and balancer, are also installed in the engine room, and a battery consisting of 230 cells, with a capacity of 400 ampere-hours, is provided. Two sets of feeder cables have been laid, terminating in feeder pillars, from which the distributing network radiates. Messrs. Crompton & Co. have been responsible for the equipment of the generating station, and Messrs. Callender for the cable work. Mr. B. G. Drummond is the resident engineer to the Electric Supply Corporation, Ltd., who are promoting the scheme.

Southend-on-Sea.—The T.C. has decided to extend the flat rate of 4½d. per unit to shops and other business premises. Hitherto the rate has been confined to private houses.

Stafford.—The report of the working of the electricity department was presented recently. The gross profit during the year was £2,127; depreciation on battery and cables would require £1,000, interest on loans £918, and sinking fund £992. A contribution from the rates to the amount of £992, being the amount of loans repaid during the year, was asked for. The report was adopted.

Stockport.—A L.G.B. inquiry was held on May 17th into the Corporation's application for a loan of £6,125 for the purchase of electric motors for hiring-out purposes. There was no opposition.

Tunbridge Wells.—Mr. Horace Boot, the consulting engineer and general manager to the Corporation electricity undertaking, was able to report a good showing for the year ended March, 1905. During the year 1,035,470 units were generated, as compared with 1,005,210 in the previous year. The revenue amounted to £13,783, as against £12,896, and the gross profit in 1903-4 was £5,413. After the deduction of the interest and sinking fund, which represents more than 6 per cent. on the whole capital, the net profit was £736. The average price obtained was 4·39d. per unit for private lighting and 1·5d. for public lighting. It might be mentioned that Tunbridge Wells has to pay 11s. 2d. railway rate, per ton of coal and 1s. 6d. per 1,000 gallons for water. The Department has now paid back by way of sinking fund, £20,000 of their original loan.

Wakefield.—There was no opposition at the L.G.B. inquiry last week into the Corporation's application for a loan of £18,000 for electric light purposes.

Wellingboro'.—The U.D.C. has decided to ask the County of Northampton E.L. Power and Traction Co. to make suggestions and submit an estimate of the cost of lighting the streets, including the working by the company of the refuse destructor, under conditions to be approved by the Council.

Wetheral.—An E.L. scheme for the district has been submitted to the P.C., and in referring the matter to the R.D.C., the Council has decided to raise no objection to it.

MESSRS. ERNEST SCOTT & MOUNTAIN'S NEW WORKS AT GATESHEAD.

The long association of Messrs. Ernest Scott & Mountain with electrical work, and more particularly with the construction of electrical mining machinery, is well known to our readers, and with the formal opening of the new Close Works at Gateshead on Saturday last, inaugurating as it did a further step in the firm's progress, a short description of these works and the developments which led to their acquisition by the firm is not inappropriate to the occasion.

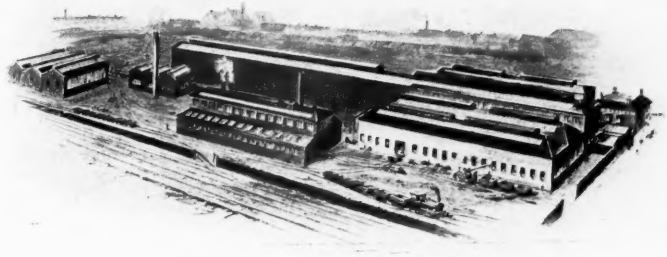


Fig. 1.—General View of the New Works.

Commencing in the year 1882, under the style of Ernest Scott & Co., when Mr. Ernest Scott purchased the original works at the Close, Newcastle, from Messrs. R. and W. Hawthorn the firm was engaged in the construction of the Gulcher Electrical Co., London, Mr. Mountain had had considerable experience, and it is of interest to note that its first dynamo was made by the firm in 1889, this being a machine for the Bingley Hall Exhibition in Birmingham, where it was successful in obtaining a medal.

For a considerable period electrical machinery for factory purposes in the industrial areas of Lancashire and Yorkshire formed the staple product of the firm, but, due to the early recognition by Mr. Mountain of the possibilities attending the use of electricity for pumping, hauling, and coal-cutting, in mining and colliery work, the energies of the firm were turned in this direction.

Fig. 2.—View of the Fitting and Erecting Shop.

auxiliary machinery for warships, and also at a later period in the building of marine engines.

With the partnership of Mr. W. C. Mountain, who joined the firm in 1888, it was decided to take up the manufacture of electrical machinery, of which as managing director of

The first contract of this description was an electrical pumping installation for the Cowpen Coal Co., near Blyth, which was carried out in 1890, and subsequent orders, both for pumping and haulage plant, followed in considerable numbers.

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Fig. 3.—Electrical Shop Taping Department.

—Electrical coal-cutting machinery was introduced by the firm at an early date; its first machine, of the disk type, being supplied to a Scotch colliery some 12 years ago.

The firm was also intimately connected with the introduction of three-phase plant for colliery work in this country, its earliest effort in this direction being for the Tredegar Coal and Iron Co., in South Wales, where some 13 haulage gears and numerous main shaft and smaller pumps are operated by means of three-phase motors.

Fig. 4.—Electrical Shop: Winding Department.

With the rapid growth of the firm's output, the works in Newcastle were found inadequate, and in 1904, the disused works of Messrs. Black, Hawthorn & Co., in Gateshead, were acquired; these have been extended and with the modern equipment and facilities which they now contain, constitute an up-to-date factory of large capacity, an illustration and plan of which are shown in figs. 1 and 7.

The total area of the site is nearly 7 acres, of which some 2 acres are under cover.

Direct access is provided to the North-Eastern Railway, which forms the boundary of the property on one side; and full-gauge railway tracks are laid into several departments of the works, so that material can be handled with a minimum of cost.

Adjoining the works is an extensive suite of offices opening out from a large waiting room; these include accommodation for the drawing office and counting-house staffs, the secretarial department and the directorate.

Commercial and works management offices, a staff and workmen's dining rooms, a time office and sundry other accommodation are also provided, and by means of a private telephone system the various departments and offices at Gateshead, and the head office in Newcastle are all interconnected.

By reference to the plan of the works, fig. 7, it will be seen that they consist of a long central bay, utilised as to one section for the heavy machinery, and as to the other, for fitting and erecting, with smaller bays on either side equipped respectively as a light machine shop, and an electrical shop and stores for finished parts.

Separated from these departments and housed in isolated buildings, are a spacious pattern shop and stores, a power house containing the electrical generating plant, from which the various motors throughout the works are supplied, and a large iron foundry.

The large central bay has a total length of 558 ft., and is 43 ft. wide; the north end is devoted to heavy machinery, which includes numerous examples of modern tools, among them being a planing machine constructed to take work 20 ft. long × 6 ft. 6 in. wide × 8 in. wide, several horizontal and vertical lathes, three boring mills (each capable of boring up to 10 ft. diameter), and sundry other planing machines and boring lathes.

The centre of this bay is utilised for core building, a large

Fig. 5.—View in the Electrical Shop, Showing Armatures Under Construction.

face-plate being provided for fitting up large cores and commutators. Hydraulic presses and sundry small tools are also provided for this section of the work.

The southern end of the bay is reserved for fitting and erection purposes, and is suitably equipped with numerous drilling machines and a great variety of portable tools. (Fig. 2.)

On completion of the erection, the work is carried by one of the 15-ton overhead electrical cranes which serve the shop, to the test-bed, situated at the extreme end.

This department is provided with every facility in the way of steam and electrical energy, for the testing of high-speed engines, dynamos and alternating current plant, and motor-driven pumping and hauling gear, &c. When the work has been satisfactorily tested it is transferred direct into railway trucks on the siding which enters this end of the centre bay, and in connection with which a heavy loco. crane is available for yard shunting and lifting.

The light machine shop, fig. 8, which, as previously stated, forms a side bay, is 234 ft. long and 34 ft. wide, and its equipment consists of the smaller lathes and machine tools.

This shop is served by a 5-ton hand crane; one extremity of the shop is enclosed and utilised as a tool store and tool-fitting department. Here the standard lathe tools are kept in specially-arranged racks, and are handed out to the workmen in exchange for brass checks, the latter being retained in the store as a record of the whereabouts of the tools. This arrangement is also carried out in connection with jigs and other accessories for machining the various work passing through the shops.

Fig. 6.—View of the Pattern Shop.

The smiths' shop is situated in an adjacent building; it contains several hearths and an electrically-driven pneumatic hammer. On the other side of the main bay are situated two parallel smaller bays, devoted respectively to electrical work and stores. Each of these is 264 ft. long and 34 ft. wide. The former, views of which are shown in figs. 3, 4 and 5, is used for armature and coil winding and taping, and, in fact, for the completion of the electrical sections of the various machines, being provided with suitable winding plant and with a large circular drying stove, heated from a vertical boiler outside the building.

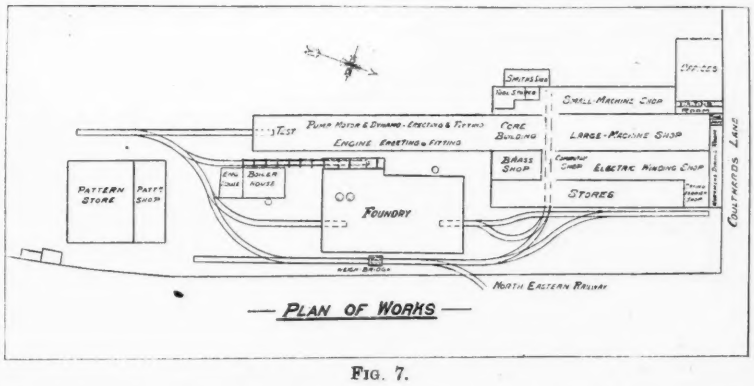

Fig. 7.

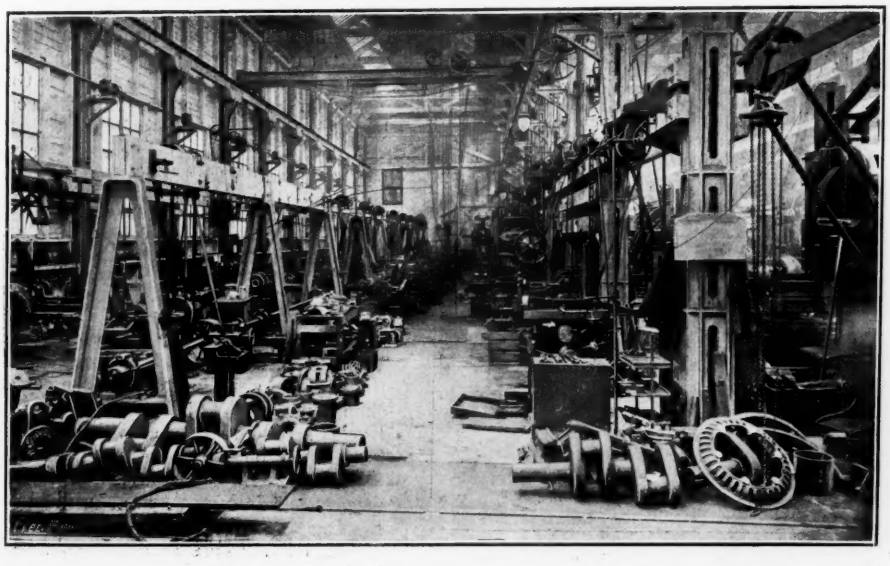

Fig. 8.—The Light Machine Shop.

The brass finishing shop is an enclosed portion of the electric shop, and it contains a number of light tools suitable for this class of work.

The uses of the stores bay are quite obvious, both it and the adjoining electric shop are provided with 5-ton cranes, and the latter has an additional 2-ton hand crane.

We understand that it is the intention of the firm to extend the three side bays, to the same length as the centre bay, in the near future.

The pattern shop and stores consist of a new building some 100 ft. long and 120 ft. wide, in three bays, one of which is enclosed for the wood-working plant.

The latter include some 25 machines of various types, driven from shafting, which in turn is operated by a 40-H.P. electric motor.

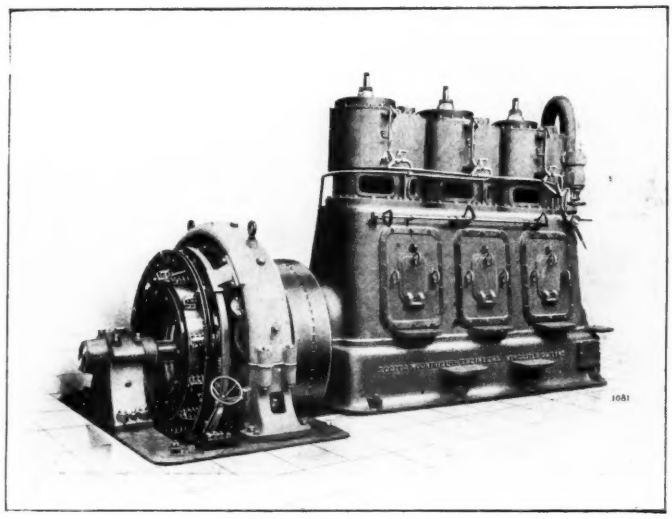

FIG. 9.—SCOTT & MOUNTAIN HIGH-SPEED DIRECT-COUPLED GENERATING SET.

Fig. 6 gives a good view of the pattern shop, in which it will be noted the centrally-situated machines are driven from underground shafting.

The pattern stores have a total floor area of some 8,000 sq. ft., and are equipped with suitable racks and frames for storing the various standard and other patterns of the firm's specialities.

The foundry is a large building, having a floor space of some 18,000 sq. ft., and is provided with two cupolas with a combined capacity of 11 tons per hour.

For the supply of the air blast, a Root's blower, driven by a 52-H.P. electric motor, is installed; the latter is also utilised for working the loam mill and cupola hoist.

The brass foundry is also under the same roof, and the light moulding is carried out in the small bay at the opposite side of the building.

A 15-ton electric crane is provided in the main bay for the heavy moulding and casting, while smaller hand cranes are used elsewhere in the foundry.

There remains yet to be described the power plant, which occupies a small detached structure adjacent to the end of the erecting shop; here is installed a modern boiler equipment, including a Babcock and Wilcox water-tube boiler, working at any pressure up to 300 lb. per sq. in., and two loco. type boilers.

The boiler house also contains boiler-feed pumps and condensing machinery for the adjacent steam plant; the air and circulating pumps for the latter being of the type supplied by the firm in large quantities to the Admiralty and private shipbuilders.

Steam is supplied for use on the test-bed in the erecting shop adjoining, and also to a vertical compound engine of 250 H.P., driving through a belt a 120-KW. compound wound D.C. generator which supplies energy at 110 volts pressure, also to a direct coupled high-speed generating set having an output of 45 KW.

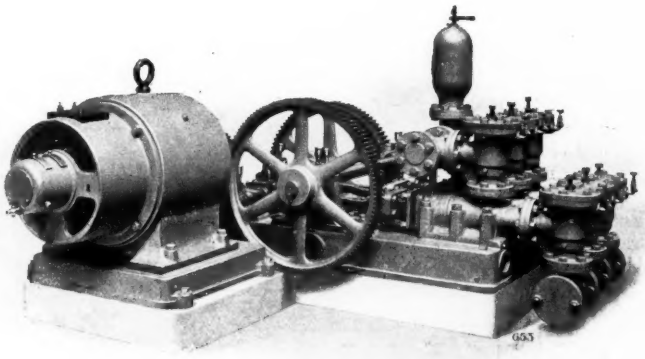

FIG. 10.—ELECTRICALLY-DRIVEN THREE-THROW MINING PUMP.

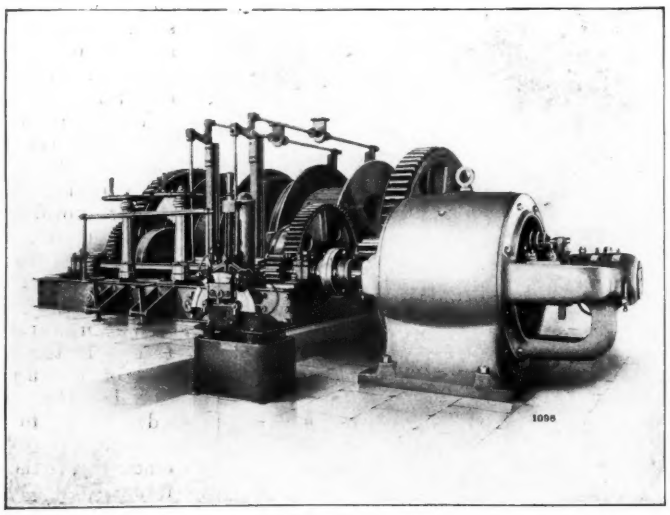

FIG. 11.—ELECTRICAL WINDING GEAR.

A works' switchboard is provided for controlling the various lighting and power circuits throughout the shops; an additional supply of energy is available from the Gateshead electric supply station, from which cables have been brought to the switchboard.

An electrically-driven air compressor plant is also situated in the building, and is used for operating the numerous portable tools in the main shops.

Electricity is supplied to the various sections of the works, in which some 42 electric motors are in use for driving groups of tools through sections of shafting; the total H.P. of these machines being 400. Energy is also supplied to the testing switchboard in the erecting shop, and to a 250-H.P. motor of the firm's three-bearing type, which is utilised for test purposes.

Some 72 1,000-C.P. arc, and numerous incandescent lamps are utilised for lighting the works and offices, and the various buildings are heated in cold weather by means of a steam-heating system.

The erection of the new shops, and the general laying out of the works, have been carried out to the designs, and under the superintendence of Mr. W. S. Vaughan, of Messrs. Vaughan & Dymond, of Newcastle-on-Tyne.

The new works having been utilised for some little time prior to their formal opening, the numerous visitors on that occasion were enabled to inspect a large amount of electrical mining and pumping plant, and generating machinery in course of construction and completed. This included large and small examples of electrically-driven horizontal three-throw pumps; electrical winding gears, fitted with double drums for winding from two levels, and with single drums, driven by D.C. and polyphase motors, also endless haulage gears of various types.

A Scott & Mountain three-crank compound high-speed engine was shown under steam and three similar engines of the same size, *i.e.*, 300 H.P., were under construction in the shops. Among the miscellaneous plant were numerous examples of generators and motors, centrifugal and sinking pumps, and of electrical coal-cutters of the disk type, for both three-phase and D.C. working.

The above gave an excellent idea of the specialised character of the firm's products, specimens of which are shown in figs. 9, 10 and 11, and, with the extended capacity and greater facilities available in the new works, it seems highly probable that Messrs. Scott & Mountain will become even more identified with electrical mining plant in the future, than they have been in the past.

TRAMWAY AND RAILWAY NOTES.

Batley.—Arrangements have now been completed for the electrification of the steam tramways from Dewsbury to Batley, Birstall and Gomersal. Some time ago the B.E.T. Co., who own the tramways, accepted the tender of Messrs. Dick, Kerr & Co. for the reconstruction of the whole of the line with the exception of the portion in the borough of Batley, and the Corporation of Batley has now accepted the tender of the same firm for the relaying of this part of the line. There will be a double track from Dewsbury to Birstall, and from thence a single track to Birkenshaw, where the terminus will practically join up to the Bradford City tramways. It is hoped to have a section of the line ready for opening by the end of July, and the whole system completed by autumn. At Dewsbury and Birkenshaw junctions will be made with the Dewsbury and Spen Valley systems.

Bexley.—The U.D.C. has consented to Dartford U.D.C. connecting its electric tramway system with that at Bexley.

Bonnyrigg.—The T.C. and the Edinburgh Suburban Electric Tramways Syndicate, Ltd., have come to terms in connection with the scheme for running electric tramways from Edinburgh city boundary to Bonnyrigg and Broomieknowe. The syndicate undertakes to light the Bonnyrigg Jubilee lamp, and provide another lamp at the termination of the tramways at Broomieknowe, free. A half-hour tramway service to Eskbank and Edinburgh is guaranteed.

The Edinburgh Suburban Electric Tramways Syndicate has now secured the approval of all the local authorities on the route it proposes to cover. The prov. order will, it is expected, be passed this week.

Continental Notes.—BELGIUM.—The Central Electrique du Nord is the title of a new company which has been formed at Brussels with a share capital of £250,000, divided into 50,000 shares, and a similar number of founder's shares has also been created. The object of the company is to undertake transport systems on railways, roads and canals, and to work stations for the supply of light and power. At the offices of the Union des Tramways, 27, Rue des Minimes, Brussels, 30,000 £4 shares in the company have been offered for public subscription, together with 10,000 bonds of £20 each. The first transaction of the Central Electrique will be to acquire 32,000 shares in the Central Electrique Lille-Roubaix-Torcoing, a French company which enjoys a 60 years' concession for electric tramways, having a total length of 38 miles, which connect the towns indicated in its title.

ASIATIC RUSSIA.—It is proposed to establish an electric tramway in Andijane, which is a town of 60,000 inhabitants in Asiatic Russia. The length of the line, which would be laid between the centre of the town and the railway station, would be 2½ miles, and the scheme also contemplates the supply of electrical energy for lighting and industrial purposes. A St. Petersburg correspondent states that the Siemens & Halske Co., of Berlin, are taking active steps in the matter in approaching the municipal authorities, and that they have sent representatives to the spot in order to endeavour to secure the contract for the electrical equipment of the projected tramway, but a decision has not yet been arrived at.

Cuba.—A new corporation which is being financed in Montreal, New York and London, has received valuable running rights on the Island of Cuba, and it is proposed to build and operate an electric railway some 120 miles in length, radiating from the city of Havana, and taking in some 50 towns which, from their geographical position, naturally look to the Cuban capital as their port. The capital of the company will be $10,000,000 bonds and $5,000,000 stock, half of which will be issued immediately, as it is calculated that this will be sufficient to complete the system as now projected.

Falkirk.—At a meeting of the T.C. on Monday evening a letter was read from the secretary to the Falkirk and District Tramway Co. asking the permission of the Council for the opening up of thoroughfares within the burgh in stretches greater than 100 yards, the maximum allowed by the Act, provided the Local Authority withholds consent. The application arose out of an interim interdict taken out against the contractors last week for opening a road in stretches of 400 yards and leaving crossings shorter than a quarter of a mile. The interdict was withdrawn on condition that the defenders abided by any stipulation that the T.C. might make, and the Council has decided not to grant the application.

"Live" Rail Guarding.—A special Darlington correspondent advises us that the "live" rail danger on electrified railways is in course of being solved in a novel manner, by means of which the risk run by workmen, trespassers, and others crossing over or walking on electric railways is greatly minimised. The electrified section of the Lancashire and Yorkshire Railway, between Liverpool and Southport, is at the present time being metalled with a very hard, marble-like stone which offers great resistance to the passage of electricity. This non-conducting ballast is obtained from an important quarry in the North Riding of Yorkshire, near Darlington. It is spread in a thin layer underneath and between the sleepers, and renders the live rail perfectly harmless to anyone coming in contact with it, unless at the same time he forms a direct circuit by touching the track rails. This particular ballast has already been adopted on the North-Eastern Railway Co.'s electrified lines in the Newcastle district, with satisfactory results.

Liverpool Overhead Railway.—Rapid progress continues to be made with the Overhead Railway Extension at Liverpool to the Lancashire and Yorkshire Electric Railway at Seaforth, and it will soon be ready for opening. Special light carriages are being built for running on the Overhead Railway and the L. and Y. line, and a frequent service of quick trains will be maintained.

London.—The Highways Committee of the L.C.C. has decided to recommend the issue of circular journey tickets, available for the tramways and steamboats, at the price of 5d. each.

The L.C.C. has decided to enter into agreements with the Middlesex County Council and the Metropolitan Electric Tramways, Ltd., providing for the construction by the Council of tramways to link up with the light railways of the Middlesex County Council at the county boundary at Highgate, the lines to be leased to the company for a period of three years.

Middlesex.—A further section of the Middlesex electric tramways, from Highgate Archway to Whetstone—a distance of some five miles—has now been completed, and will be formally opened on June 1st, in readiness for the Whitsun holidays. The line passes along the Great North Road, through East Finchley, Church End, Finchley, to Whetstone and Totteridge, within two miles of Barnet.

New York.—A serious collision occurred on the Third Avenue Elevated Railway on Monday last, 20 passengers being injured. Short-circuits occurred on the third-rail track, and some of the firemen who hastened to the spot received shocks.

New Zealand.—CHRISTCHURCH.—Our local correspondent informs us that the Tramway Board recently discussed the question of fares, and a Committee appointed has suggested the adoption of the use of discount tickets to those who travel over the system on the longer sections every day. Season tickets were in use until recently, but were not found to be satisfactory; they were cheap, £5 per annum to Sumner, a distance of eight miles. The board still desires if possible to offer some concession to regular passengers. Special tickets at half price are to be issued to children, and monthly tickets are recommended by the Committee for school children.

The arbitration proceedings between the New Brighton Tramway Co. and the board have resulted in the latter having to pay £7,267 for the company's line, or £1,752 more than was estimated. The company's claim was over £16,000.

AUCKLAND.—The City Council has resolved to make a claim on the Tramways Co. for its percentage of the profits (£1,700) made in 1902, and on the sum of £5,000 set aside out of the profits of 1903 to depreciation, and has instructed the city solicitor to demand the same.

The negotiations between the Tramways Co. and the Mount Eden Road Board have now been concluded, and it is expected that the lines in this district will soon be commenced.

Parcel Traffic.—At a meeting of the Manchester Tramways Committee last week, it was announced that Messrs. Sutton and Co. had served a writ upon the Town Clerk aimed at the collection and delivery of parcels by means of carts, &c. The plaintiff company seeks a declaration that the defendants have no power to convey, collect or deliver by means of road vans or undertake the collection of the value of goods on delivery, also an injunction restraining them from acting as carriers, and a declaration that it is unlawful for the Committee to spend money out of the city funds or the tramway receipts for any such purposes. The Committee gave instructions for the action to be defended, and counsel has been engaged.

Councillor Boyle, in the course of an interview, says the parcel traffic is the beginning of a vast system, to end in the transport of merchandise of all kinds between the Ship Canal Docks and all Lancashire towns.

Some time ago Liverpool called together a conference of all the tramway authorities in Lancashire, except Manchester and Salford, and submitted a scheme for carrying merchandise by tramway between the Liverpool Docks and all the Lancashire towns. At that time several of those towns approached Manchester as being the natural centre of distribution, and ever since taking over the tramways from the old company, the Committee has had the present scheme in hand.

The scheme has only been two months in operation, and it has met with considerable opposition by private carriers, who contend that public funds should not be utilised to subsidise competition off the route of the tramcars. If the Committee cannot collect and deliver, the whole scheme fails.

Paris Metropolitan Railway.—The annual meeting of the Paris Metropolitan Railway Co. was held in Paris on May 18th. The system, as now in service, comprises a length of close on 32 km. of double track, divided into three lines, the third, of a length of 8 km., being placed in service last autumn, and described in the ELECTRICAL REVIEW of December 2nd, 1904. The total receipts for 1904 were 20,662,297 fr. and the expenses 8,779,645 fr., giving a ratio of expenses to receipts of 42·49 per cent. The ratio for 1903 was 42·9, and for 1902 41·52. The gross profits of the company were 11,882,652 fr., and after deduction of the fixed rent due to the City of Paris, as interest on the capital expenditure for tunnels and viaducts, &c., which was borne by the municipality, the net profits of the company amounted to 5,210,111 fr. As there were but 30 km. in service until the end of 1904 (when the last part of Line 3 was formally opened), the net profits per kilometre amounted to 200,104 fr.

The rolling stock of the company consists of motor-cars and trail-cars, no locomotives being in service. The total number of cars of all descriptions is 695. Of these, considerably over half are two-axle cars, and these are now being transformed into four-axle cars as fast as the service permits. As the cars are converted a metallic driver's cab is added, instead of the former wooden compartment.

The dividend declared was the same as the previous year—*i.e.*, 8 per cent. on the paid-up capital. The special pension fund, created in 1904, was further increased by 500,000 fr., and a sum of 273,490 fr. was carried forward for next account. The present paid-up capital of the company is about 70,000,000 fr.

In view of the completion of the southern section of Line 2, it is proposed to issue debentures, and resolutions to this effect were passed at the meeting. The viaducts across the Seine at Austerlitz and at Passy are all that remain to complete Line 2, which will be opened for service in a few months from date. The line itself, including stations, tunnels, and viaducts, has been ready for some months. When this line is finished the first section of the Metropolitan Railway will be complete, and the concession, which runs for a term of 35 years, will then commence to take effect.

It was stated at the meeting that the second section of the railway, comprising Lines 4, 5 and 6, would be handed over to the company by the municipality during the course of 1906 and the beginning of 1907.

The third section is only as yet in the preliminary stages. Two lines only, with certain extensions of existing lines, are included in this section.

During 1904 a seventh generating group was added to the Bercy power station, and, with an addition now being made, the output of this station will attain 14,000 KW. by the end of the present year. The sub-stations Père Lachaise and Opera, used in connection with line No. 3, were placed in service during 1904, making a total of five sub-stations in service out of eight or nine provided in the scheme of the Metropolitan network.

The large power station at St. Denis, containing 20,000 KW. (to be increased to 40,000 KW.) of Brown-Boveri-Parsons steam turbine groups, will be opened in the course of the present year, and power will be supplied to the Metropolitan Co. from January 1st, 1906.

In the discussion of the report, it appeared that the question of lifts had been occupying the attention of the company, especially with respect to the deeper level stations of the Etoile and others. An arrangement has not yet been come to with the municipality in respect to the payment for the installation.

A notable modification in the stations during 1904 was the placing of double exits at opposite ends of the stations, one of which is reserved for exit in case of accident, like the disaster of 1903.

St. Helens.—Each night the tramcars on the St. Helens and Prescot section are subjected to occasional attacks of stone throwing, though nothing very serious has happened. On Friday night the passengers in one of the cars starting from Bridge Street, St. Helens, were alarmed by a loud report. An investigation was made, and it was found that a railway fog signal had been placed on the line. The tramway manager has taken out another summons for assault. Both tradesmen and residents complain of the great inconvenience and loss of trade caused by the strike, and it is expected that the service will be considerably increased before long.

Wednesbury.—At a special meeting of the T.C. last week the members confirmed the agreement with the South Staffordshire Tramways Co. for the purchase by the Corporation from the company of the tramways in the borough. The tramways company has undertaken to proceed with the reconstruction of the line between Dudley and Wednesbury as soon as it has completed the portion between Wednesbury and Darlaston.

Poole.—The town clerk has been instructed to apply to the B. of T. for permission to borrow the sum of £50,000, being the proportion of the purchase money of the Poole and District Light Railway agreed to be provided by this Council, and also the estimated amount of the costs incurred by the Council in connection with the purchase of the said undertaking. It was stated that a similar amount would have to be paid by the Branksome U.D.C. to make the undertaking the joint property of Poole and Branksome.

Southend Pier.—During the past 12 months 600,000 people travelled by the tramway on the pier, and there was not a single accident of any kind.

TELEGRAPH AND TELEPHONE NOTES.

Anglo-Chinese Telegraphs.—A Convention was signed on Tuesday between China and Great Britain, renewing Article 16 of the Burma Convention of 1894 respecting a junction between the Burma and China telegraph lines, with a modification of rates to meet the general lowering of rates of submarine cables. The article, owing to Chinese neglect of the Yun-nan lines, has hitherto been a dead letter.—*Times.*

Brighton Telephone Accounts.—The balance-sheet for the first year's working of the Brighton Corporation telephones was issued recently. It showed a profit balance, after all charges were made, of £413 14s. 4d. The total debt created amounts to £45,859 9s. 1d.

REVENUE ACCOUNT.

The gross income, almost entirely arising from rentals and tolls, stands at		£6,787	16 10
Operating expenses		1,814	13 4
Repairs, maintenance and renewals		496	5 1
Rents, rates and insurance		212	8 0
Management expenses (including Town Hall charges £171 10s. 11d.)		1,279	3 10
Total expenditure		£3,802	10 8
Revenue as above	£6,787	16	10
Expenditure	3,802	10	8
Gross profit		£2,985	6 7
Interest	£1,093	14	4
Income-tax	25	13	0
Provision for bad debts	125	0	0
Sinking fund	1,327	4	11
	£2,571	12	8
Gross profits	£2,985	6	7
Loan charges, &c.	2,571	12	8
Net profit	£413	14	4

The capital expenditure stands as follows:—

Switchroom	£1,188	7	5
Underground construction	19,382	16	2
Overhead construction	9,669	18	6
Exchange construction	4,356	19	8
Instruments	6,006	5	4
Plant and tools	455	6	10
Office furniture	321	16	4
Preliminary and general expenses	1,988	12	6
Engineer's commission	2,003	8	4

China.—The *Standard* Shanghai correspondent states that the landing of German marines at Haichu was for the purpose of choosing a landing place for the cable which is now being laid between Java, Shanghai and Tsing-tau by the Netherlands and German Governments.

Handbook for Telegraphists.—Mr. G. Evans, an official of the Deutsch-Atlantische Telegraphen-Gesellschaft, intends issuing about October 1st next an International Handbook for Telegraphists for 1906. The book is to be published in English, German and French at the price of 3s., and the following subjects will be found therein, viz.:—Diary; list of telegraph companies and their lines; the principal points of the International Telegraph Convention, chief rules, tariffs, &c.; vocabulary of the most commonly-used forms for service telegrams; training of telegraphists; new inventions, &c.

Imperial Cable Policy.—The Chancellor of the Exchequer has consented to receive on June 8th a deputation from the Imperial Communications Committee of the House of Commons, headed by Sir Edward Sassoon, M.P., for the purpose of discussing the general lines of cable policy, and recommending reductions in the rates to West Africa and India; also to call special attention to the action of one of the co-partners to the Pacific cable conference.

London.—ST. PANCRAS.—The engineer and surveyor having reported that the telegraph wires had been blown down in the Highgate Road, and that the Post Office authorities, in spite of his application to have the wires fixed underground, were placing them on new poles, the Borough Council is to draw the attention of the Postmaster-General to the fact that the multiplication of overhead wires is regarded by it with great objection, and that, as conduits have been laid underground, the permission by the late Vestry for the erection of the poles in Highgate Road must be withdrawn, as the necessity for their continuance no longer exists.

WESTMINSTER.—The Works Committee reported having received a letter from the Postmaster-General with reference to the city

engineer's measurements of paving reinstated by the Council after Post Office trenches in the year 1903, stating that the dimensions given by the P.O. authorities were sufficient to reinstate the pavement. As the city engineer had been unable to make any allowance, the Secretary to the Post Office now intimated that the Postmaster-General could not pay the account, as his liability was limited to restoring the pavement to the condition in which it was prior to being opened, and the dimensions given were sufficient to admit of this obligation being complied with. The Committee recommended that the Postmaster-General be informed that the Council did not see its way to amend the accounts, and requested payment accordingly. This was agreed to.

Multiple Telegraphy.—Van Rysselberghe succeeded in sending telegraph and telephone messages over the same wires simultaneously by smoothing down the sharp ends of the telegraph signals with inductive coils in order not to affect the telephone, and inserting a condenser between the telephone apparatus and the line. M. Picard, of the French Telegraph Administration, has brought out a system of multiple telegraphy by ordinary currents and undulatory or alternating currents, working simultaneously, which is evidently based on the Van Rysselberghe system. The ordinary currents pass through an inductive coil before they enter the line, and the undulatory or alternating currents charge a condenser connected between their sending apparatus and the line. These currents indirectly charge the condenser through a transformer or induction coil, the secondary circuit being connected to the condenser, and the primary circuit to the sending key and source of current. In the case of undulatory or vibratory currents the primary circuit is interrupted by a vibratory interruptor, as in the phonopore telegraph. In both the ordinary and the undulatory or alternating currents the sending and receiving apparatus are connected up by switches.

Tangier-Cadiz.—The French cable between Tangier and Cadiz was opened for public use on the 16th inst., says a Reuter telegram.

Telegraphic Interruptions and Repairs :—

Cables.		Interrupted.	Repaired.
Trinidad-Demerara (No. 1)		Aug. 26, 1901	
Trinidad-Demerara (No. 2)		May 11, 1905	
St. Lucia-Martinique		May 7, 1902	
Dominica-Martinique		May 7, 1902	
Cayenne-Pinheiro		Aug. 13, 1902	
Reissa-Issa (Yemen) Camaran		Oct. 22, 1902	
Tarifa-Tangier		Jan. 16, 1904	
Closed: Vladivostok-Nagasaki		Feb. 9, 1904	
Closed: Port Arthur-Chifu		Mar. 9, 1904	
Jamaica-Colon		Jan. 5, 1905	
Bathurst-Bissao		April 22, 1905	
Cape Haite-Mole St. Nicholas		April 28, 1905	
San Domingo-Curacao		May 5, 1905	
Bonny-Duala		May 12, 1905	May 20
Dakar-Conakry		May 11, 1905	
Landlines.			
Puerto-Barrios		July 28, 1902	
Kertch-Soutchoum		Sept. 27, 1904	

Telephone Agreement. — A deputation from the National Association of Telephone Operators waited upon the Postmaster-General last Thursday. The deputation, which represented the day and night operating staff in the employment of the National Telephone Co. in London, Liverpool and Manchester, requested a guarantee of continuity of engagement, the superannuation to be based upon the whole period of service according to precedents established by the Telegraph Act and the Metropolitan Water Act, and that they should be put in every respect on a level with the members of the Government telephone staff in a like grade at the date of transfer. They also asked that seniority should in all cases be based upon the whole period of service, and that no fresh medical test should be required. Lord Stanley's reply was sympathetic, but he could not yield on the question of superannuation, the precedents quoted being, in his opinion, bad ones.

The motion for the appointment of the Post Office Telephone Agreement Committee came up before the House of Commons on Monday. Fears were expressed by several members of the Opposition that the Committee's functions would be confined to registering its approval of the agreement.

Lord Stanley said the Committee would have all the powers of an ordinary Select Committee, and could make the fullest inquiry, and report to the House, but it would not have power to alter the terms of the agreement. It might, however, make recommendations, and he would have to consider whether, in view of those recommendations, if any, he could go on with the agreement, and the House would have to consider whether it should be accepted as a whole. If the House did not accept it, it would fall to the ground, and he or a future Postmaster-General would have to make a fresh agreement. He promised that the House should have an opportunity of saying yea or nay to the agreement before August 31st.

It was pointed out by the Opposition that the Committee, though it might make recommendations, would have to report either that the agreement should be affirmed or that it should not. There was no middle course, and it was urged that it should have full liberty to make any report it thought fit.

Lord Stanley ultimately agreed to the insertion of words under which the Committee, if it made any recommendations as to modifications in the agreement, might report whether it should be affirmed with such modifications.

Telephone v. Telegraph.—Owing to the growing use of the telephone and the express letter service, says the *Daily Mail*, the telegraph delivery office in Moorgate Street Buildings, E.C., is to be closed at Whitsuntide. Inquiries are now being conducted which may result in the closing of other telegraph offices.

Tory Island Cable.—Telegraphic communication with Tory Island is interrupted owing to a mishap to the cable which connects it with the mainland. The Government cable steamer *Monarch* arrived in Lough Swilly on 21st inst. to effect the necessary repairs. It is at Tory Island that Atlantic liners are first spoken, which proceed by the North Irish Coast route to England.—*Standard.*

Wireless Telegraphy.—An Ottawa correspondent of the *Standard* telegraphs an announcement by the Canadian Minister of Marine that an arrangement has been made with the British Government to pass a general law regulating wireless telegraph systems. The announcement was made in connection with the passing by the Railway Committee of the Bill incorporating the Fessenden Wireless Telegraph Company of Canada. It is pointed out that an Act was passed last year dealing with wireless telegraphy, and that nothing is known at the Post Office of any further legislation. Licences are now being issued under the Statute of 1904.

Wireless Turns.—The Press now announces the fact that wireless telegraphy has reached the variety stage. Captain Bloom, at the Empire Theatre, gives entertaining illustrations of the use of the Marconi system for various purposes.

CONTRACTS OPEN AND CLOSED.

OPEN.

Bangour Village.—May 27th. Edinburgh District Lunacy Board wants offers for boilers, engines and dynamos, economisers, cranes, battery, switchboard, cables. Electrical engineers, Messrs. Buchan and Hogarth, 16, Rutland Square, Edinburgh. Architect, Mr. H. J. Blanc, 25, Rutland Square, Edinburgh.

Bracebridge Asylum.—June 7th. Fire alarms, telephones, bells, and tell-tale clocks, for this Asylum. See "Official Notices" May 19th.

Brecon and Radnor Asylum.—June 7th. Wiring and motors for the new farm buildings, also fire alarm installation at the Asylum. See "Official Notices" May 19th.

Burslem.—May 30th. The Corporation invites tenders for wiring the Town Hall, Markets, &c., also for house service fuses and meters. Mr. Ashton Bremner, borough electrical engineer.

Dublin.—May 30th. The Cleansing Committee wants tenders for tank wagons, covered tipping wagons, &c., for conveying city refuse over the tramway routes. City engineer, Mr. Spencer Harty, City Hall.

Eastbourne.—June 9th. Concentric cable for the Corporation. See "Official Notices" to-day.

Edinburgh.—May 30th. Switchboard panel extension for McDonald Road station. See "Official Notices" May 12th.

Edinburgh.—May 31st. The Parish Council invites tenders for electric light installation and new electric passenger lift in connection with the extension and reconstruction of the Council Offices, Castle Terrace. Mr. R. M. Cameron, architect, 53, Great King Street, Edinburgh.

Edinburgh.—June 5th. Cables for Electricity Supply Department for one year. See "Official Notices" to-day.

Edinburgh.—June 6th. Steam and exhaust pipe-work for the McDonald Road electricity station. See "Official Notices" May 19th.

Hammersmith.—June 2nd. British manufacturers are invited to quote the Council for the hire of materials for electrical distribution to the stands at the Olympia Electrical Exhibition in September. See "Official Notices" to-day.

Kettering.—May 29th. Nernst lamps, posts, &c., for street lighting. See "Official Notices" May 5th.

Melbourne.—July 14th. Arc lamps, poles, brackets, &c., for street lighting for the Council. See "Official Notices" May 12th.

Ossett.—June 14th. High-speed engines, dynamos, booster and balancers, battery, switchboard, crane and cables. See "Official Notices" to-day.

Partick.—June 6th. Water-tube boiler, switchboard extensions, coal conveyor, bunkers, feeder cable, &c. See "Official Notices" May 19th.

Radcliffe.—May 30th. One 250-KW. steam dynamo for electricity works extensions. See "Official Notices" May 19th.

Spain.—June 4th. The Spanish Ministry of Posts and Telegraphs in Madrid is inviting tenders, until June 4th, for the supply of 50 tons of galvanised iron telegraph wire, 4 mm. diameter and 5 tons of bronze wire, 3 mm. diameter. Particulars may be obtained from, and tenders are to be sent to, La Direccion General de Correos y Telegraphos, Carretas, 3, Madrid.

Swansea.—June 5th. Two motor-alternators for the Corporation. See "Official Notices" May 19th.

Todmorden.—June 8th. Pipework for the electricity works. See "Official Notices" to-day.

CLOSED.

Batley.—The Corporation has accepted the tender of Messrs. Dick, Kerr & Co., Ltd., for permanent way and overhead work for the double line of tramways in Bradford Road. The paving will be done by the Corporation.

Bury (Lancs.).—The Board of Guardians has accepted the tender of Messrs. F. W. Smith & Co., Ltd., of Salford, for the wiring of the Hospital for the E.L., at £830.

Deptford.—The B.C. has accepted a tender by the Hart Accumulator Co., Ltd., to maintain the batteries at the baths and wash-houses for five years, at £14 17s. per annum.

East Ham.—The T.C. has placed an order for a 10-ton weighbridge, for the generating station, with Messrs. Pooley and Sons, Ltd.

Erith.—The U.D.C. has accepted the tender of Messrs. Babcock & Wilcox, Ltd., for pipework at the Electricity Works, at £445.

Faversham.—The T.C. has accepted the tender of the Campbell Gas Engine Co., Ltd., of Halifax, for the supply of additional plant for the E.L. station, at £4,183.

Holland.—Messrs. R. W. Blackwell, Ltd., London, succeeded in submitting the lowest tender (47,434 fl.) for the supply and erection of the overhead conductors for the municipal electric tramways in Utrecht.

London.—The L.C.C. has given a contract for 500,000 stoneware ducts, for tramway cables, to Messrs. G. Skey & Co., Ltd., for £6,287, and to Messrs. Stanley Bros., for 250,000 ducts, for £3,450.

The tender of the Tudor Accumulator Co. is recommended for the supply of a battery for Greenwich power station, at £1,876, and for maintenance for 10 years, for £1,120.

The tender of Messrs. Carrick & Ritchie is recommended for acceptance for three overhead travelling hand cranes for sub-stations, for £678.

Marylebone.—The B.C. has placed an order with the St. Helens Cable Co., Ltd., for 10 miles of ·03 concentric cable, at £154 12s. per mile; three miles of ·03 triple-concentric cable, at £287 4s. per mile; two miles of ·06 triple-concentric cable, at £362 8s. per mile, and one mile of ·1 triple-concentric, at £474 8s. per mile.

The Council has also accepted the tender of Messrs. Wm. Cory and Son, Ltd., for 6,000 tons of coal, at the following prices:—Broomhill, at 12s. per ton; Shipley, 12s. 1d.; and Babbington, 12s. 6d.

FORTHCOMING EVENTS.

To-day's Arrangements.—At 5 p.m. At 92, Victoria Street, S.W. I.E.E. Annual General Meeting.

At 3.30. p.m. Physical Society Meeting at the National Physical Laboratory, Bushey Park, Teddington. "The Specific Heat of Iron at High Temperatures," by Dr. Harker. "The Measurement of Small Inductances," by Mr. Campbell.

Tuesday, May 30th.—At 8 p.m. Optical Convention, 1905. Opening Ceremony to be held at the Northampton Institute. Closes on Saturday, June 3rd.

Thursday, June 1st.—At 5 p.m. Royal Institution. Tyndall Lecture by Prof. J. A. Fleming on "Electro-Magnetic Waves." (Lecture II.) At 8 p.m. Chemical Society. Meeting.

Thursday, June 1st and Friday, June 2nd.—At 11 a.m. and 10.30 a.m. respectively. Institution of Mining Engineers. Meeting in London at Burlington House. For further particulars see our "Notes" columns.

THE ELECTRICAL ENGINEERS R.E. (VOLS.).

THE following orders have been issued for next week:—

Monday, May 29th.—"A" Company. Technical Instruction, 7 p.m. Projector Drill, 7 till 9 p.m., for Teams.
Tuesday, May 30th.—"B" Company. Technical Instruction, 8 p.m. Projector Drill, 7 till 9 p.m., for Teams.
Wednesday, May 31st.—No Adjutant's Drill. Projector Drill for Teams, Members of all Companies, 7 till 9 p.m.
Thursday, June 1st.—"C" Company. Technical Instruction, 8 p.m. Projector Drill, 7 till 9 p.m., for Teams.
Friday, June 2nd.—"D" Company. Technical Instruction, 7 p.m. Projector Drill, 7 till 9 p.m., for Teams.

NOTICE.—Recruiting will cease until after Camps.

J. J. F. O'SHAUGHNESSY, Captain.
For O.C.E.E.R.E. (V.

NOTES.

The Happy Dispatch.—Much nonsense is being promulgated by the daily Press, and also in the House of Commons Committee, in support of the Metropolitan Pneumatic Dispatch Bill, which embodies a scheme for putting down 95 miles of double tubes for the dispatch of parcels to every part of London.

Civil engineers of reputation, borough engineers and others, have given evidence before the Parliamentary Commission in an authoritative manner, and we doubt if the majority of them have ever had an hour's real experience of pneumatic dispatch working. We doubt, indeed, whether they have ever seen a pneumatic system other than the experimental Batcheller line.

It is highly probable that the writer of this little script and Mr. H. F. Joel are the only men left to tell the tale of the actual daily operation of the tube laid by the old Pneumatic Dispatch Co. between Euston Station and the General Post Office; but a writer in the *Evening Standard and St. James's Gazette* lays before the readers of our evening contemporary some startling news of the projects, failures and achievements of pneumatic transmission. We are gravely informed that the tube above mentioned was 4 *ft.* 6 in. *in circumference*, and that the carriages were 10 ft. long × 4 ft. *broad!* How were those carriages ever got into that tube? As a matter of fact, the tube was shaped like the letter D lying on its flat side, and measured 4 ft. 6 in. high × 4 ft. in width.

These abandoned tubes—they were really very well behaved in all respects—the writer tells us, are still *in situ*, "for the workmanship put into them was splendid." They were made of cast-iron, and would not pay as scrap metal for the breaking up of the streets to recover them.

Many distinguished persons made the trip from St. Martin's-le-Grand to Euston, having to lie, says our informant, on their backs in a spare car. As a matter of fact, the people who went through that tube sat up! What need to stretch oneself prone in a carriage which fitted a tube of the dimensions given? We might take exception to other points, but we have said enough to show once again what we have laboured for so many years, the absolute necessity of having technically educated men on the staff of the daily Press to deal with engineering and technical subjects.

Theory of the Electrolytic Rectifier.—Experiments carried out by Mr. S. R. Cook, and recorded in the *Physical Review*, Vol. XX., No. 5, lead to the following conclusions:—

1. The high apparent resistance of the electrolytic rectifier, when aluminium is the anode, is due to the counter-electromotive force produced by the difference in charge of the cations around the carbon plate and that of the anions around the aluminium plate.

2. So long as the potential is below the critical value, the resistance of the film to the transfer of electricity is such that very few of the anions pass through it.

2. When the aluminium is the cathode, hydrogen forms between the metallic aluminium and the film; this breaks the film and exposes metallic aluminium, thus allowing only a small polarisation and hence a low resistance.

4. It has been shown that there exist two potentials, depending on the temperature, at which the film of aluminium undergoes a change such that its resistance to the passage of the ions is decreased, the first being at a potential whose value is about one-third the value of the second. The second is at the critical value of the potential and is due to the crystallisation of the film.

Nitrogen of Lime.—It was announced a few months ago that the first practical application of the patents for the production of the new fertiliser known as nitrogen of lime would be made in Italy. It is now stated that the Cyanid Gesellschaft, which is closely associated with the Siemens & Halske Co., and which acquired from the latter all the principal home and foreign patents for the process, is taking steps for the working of the method on a large scale in Austria-Hungary. For this purpose works capable of turning out 4,000 tons of the new fertiliser per annum are to be established in connection with the carbide works at Sebenico, in Dalmatia. These works have 20,000 H.P. available, and being located directly on the coast, are very favourably situated for the export trade. It is expected that further contracts will be speedily concluded, as negotiations are proceeding for the granting of licences to manufacture in other countries.

Electrical Contractors' Association (Incorporated), Northern Section.—The annual meeting of this Section was held at Blackpool on May 20th, Mr. J. Mc.Dermott, of Ashton-under-Lyne, in the chair. The following officers were elected for the ensuing year:—

Chairman—Mr. W. Sutton, of Liverpool.
Hon. Treasurer—Mr. T. G. Usher, of Newcastle-on-Tyne.
Hon. Secretary—Mr. W. Cross, 4, St. Nicholas Buildings, Newcastle-on-Tyne.

The annual report was adopted, and other routine business was transacted. The report stated that the Association now had powers which gave it the status necessary to make it a recognised power for the good of the electrical fraternity. The agreement with the National Electrical Manufacturers' Association worked well, but was unfortunately cancelled on December 31st, 1904; the thanks of all members are due to the joint committee for the fair and careful manner in which they treated the large number of cases (many of them difficult) with which they had to deal; the Central Board is fully dealing with this subject of fair trading, and it is expected that very shortly it will be able to place before the members a scheme which will be beneficial to all. During the year 12 members resigned and 25 new members joined, making a total on May 1st, 1905, of 82 members; of these new members, eight are in business in Bradford and district, having joined the Leeds branch. The report says:—"The matter of fair tendering has engaged attention; in one case of an architect selling specifications, very strong action was taken, and the board was pleased to find that several members had individually refused to quote under those conditions. This matter has been largely commented on in the technical Press, the prompt action of your executive having in a great measure contributed to the prominence given to the case. The scheme for the registration of workmen continues to be increasingly useful; members are however requested to ensure that all workmen leaving their employment are provided with a card, in this way only can the efficiency of the system be enhanced. No trouble with workmen has been reported. The prompt action taken by the Manchester branch relating to false reports in the daily Press in October last respecting fires caused by electrical faults, emphasised the usefulness and the many means by which the Association can serve its members."

Alleged Theft of Energy.—At the South Shields Petty Sessions on the 16th inst. Thomas Taggett, of Hebburn-on-Tyne, was charged with having stolen electrical energy, the property of the Northern Counties Electricity Supply Co. It was alleged that Taggett, by using undue pressure on the knob of a penny-in-the-slot meter, had turned the pointer round and broken the mechanism of the slot which enabled him to obtain light without payment. Mrs. Taggett denied that the meter had been tampered with, and said that on the night upon which the meter was taken away a penny was put in and the light utilised. The Bench considered that there was a *primâ facie* case, and Taggett was committed for trial at the Sessions, bail being allowed.

Electrical Workers in Germany.—The number of actual workers in the German electrical industry at the present time is nearly three times that of ten years ago. According to official statistics there were 26,321 persons engaged in the various branches in 1895, and these were increased to 54,417 in 1903. It is estimated by the Association for the Protection of the Economic Interests of the Electrical Industry that the total number has now advanced to 72,500 persons, who are distributed as follows:—

Employed by	In Electrical Departments.
Allgemeine Co.	17,500
Siemens-Schuckert Co.	12,000
Other works (225)	43,000
Total...	72,500

It is important to note that the total of 17,500 persons in the case of the Allgemeine Co. does not include the 11,500 workers who are employed by the same company in the production of turbines, gas engines, copper and brass goods, automobiles, wire ropes, &c. While the figures for the Siemens-Schuckert works exclude the persons engaged in the installation offices, and in the special factories of the original Siemens & Halske Co. The two leading groups thus employ 40 per cent. of the aggregate number of workers who are actually occupied in the production of electrical manufactures.

News of Tesla.—From the *Globe* of May 19th we cull the following, for which we take no responsibility:—"At last, Mr. Nikola Tesla, after a long isolation in his experimental tower of Wardenclyffe, Long Island, has broken silence in a United States patent recently granted to him. It appears from the specifications that he has been sending electrical oscillations through the ground by means of a powerful transformer having one end of the secondary coil to earth and the other to an elevated metal disk, probably the colossal griddle on the summit of his tower. He was led to do so by observing that lightning discharges produce electric waves or oscillations in the ground, varying in length from about 25 to 70 metres. His apparatus produces waves of similar kind, which travel to great distances, and they not only transmit messages, but control or actuate apparatus for other purposes—such as indicating the time of an observatory, determining the position and distance of bodies, and the course or speed of a ship at sea.

"According to his patent, the electric waves from the earth-plate travel to distant parts of the earth, and are there reflected back on themselves, producing by interference with the outgoing waves a series of stationary waves having crests and hollows lying in parallel circles round the earthplate as a pole. By impressing on the earth two or more oscillations of different wave length, a resonant stationary wave can be made to travel slowly over the globe. A delicate receiving apparatus has been invented for detecting these resonant waves. It consists essentially of a condenser charged from the ground and discharged through an indicating or a recording instrument. In any part of the globe, the wave-length of a resonant stationary wave can be found by mathematics, and the distance of the place from the source of waves calculated. A ship can thus find its latitude or longitude, time, &c. With several generators in chosen localities, the entire globe could be sub-divided into different zones of electrical activity, and important data obtained from observation of the waves."

Institution Notes.—Institution of Electrical Engineers (Birmingham Section).—The report which came before the annual meeting on May 10th, showed that the membership during the year had increased by 35, from 258 to 293. A premium of £10 was awarded for the paper on "Some Uses of the Oscillograph," read by Messrs. D. K. Morris and J. K. Catterson-Smith in the previous Session. The following are the officers for the 1905-6 Session:—

Committee, 1905-6.

Past Chairmen—Sir Oliver Lodge, F.R.S. (1900-2); Henry Lea, M.Inst.C.E. (1902-3); J. C. Vaudrey, M.Inst.C.E. (1903-4); W. E. Sumpner, D.Sc. (1904-5).
Chairman—R. Threlfall, F.R.S.
Vice-Chairman—R. A. Chattock.
Ordinary Members of Committee—Messrs. A. H. Bate, W. Brew, W. E. Groves, S. H. Holden, R. C. Jackson, G. Kapp, M.Inst.C.E., J. H. McLean, R. K. Morcom, R. Orsettich, C. E. C. Shawfield.
Hon. Secretary—D. K. Morris.
Assistant Hon. Secretary—H. B. Matthews.

The Committee records with very great regret the death of one of its number, Mr. R. H. Housman, who has acted on the Committee since 1902.

Institution of Mining Engineers.—The next general meeting is to be held in London at Burlington House, at 11 a.m. on June 1st, and at 10·30 a.m. on June 2nd, when the following papers, among others, will be read:—"The Firing of Babcock Boilers with Coke-oven Gases," by Mr. T. Y. Greener; "Note Supplementary to a Paper on the Electric Driving of Winding Gears," by Mr. F. Hird; "Electric Winding Engines at the Exhibition of the North of France, Arras, Pas-de-Calais," by Mr. Ed. Lozé. The following will be open for discussion:—"The Problem of Dynamic Balance," by Mr. E. H. Robertson; "Alternating Currents and their Possible Application to Mining Operations." Part II.: "How Alternating Current May be Used in Mining," by Mr. G. F. Walker. At 7 p.m. on June 1st, a dinner is to be held at the Holborn Restaurant; on the 2nd, at 3 p.m., a visit is to be paid to the tunnel works of the Great Northern, Piccadilly and Brompton Railway; and on Saturday, the 3rd, at 10 a.m., an excursion to Lot's Road power station of the Underground Electric Railways Co. of London, has been arranged.

Society of Arts.—On Monday last Mr. H. W. Ravenshaw delivered the second of his Cantor Lectures on "The Use of Electricity in Mines."

Electrolytic Production of Chlorates.—A German patent has been taken out by Dr. H. Landolt, of Turgi, in Switzerland, for an electrolytic process of converting the chlorides of alkali or alkaline earth metals into the corresponding chlorates, in which the essential feature consists in an addition to the bath of a chloride of lime solution. This has the effect of causing the formation of a layer of lime upon the cathode, which hinders any reducing action, and of producing free hypochlorous acid at the anode which assists in the oxidation, and so increases the yield of chlorate. The electrolyte is composed of, say, a saturated solution of common salt, to every 100 litres of which 2 litres of a clear bleaching powder solution, containing 100 grammes of active chlorine—or an equivalent quantity of another solution—have been added. The current is passed between a platinum anode and an iron cathode, the density at the latter being 1,000 amperes per sq. metre. The operation is begun in the cold, but the temperature of the bath soon rises to 80° or 100° C. After several days, the amount of sodium chlorate in the liquid will have risen to 600 or 700 grammes per litre. It is then run out of the bath, allowed to cool, and the considerable quantity of chlorate which crystallises out is removed, washed free from mother liquor, and dried. The residual liquor can be returned to the cell or worked up further by concentration or more thorough cooling. The current efficiency of the process is stated to be almost the theoretical at the start, never falling below 80 per cent., provided care is taken to maintain the proportion of active chlorine in the electrolyte at the above-mentioned figure by repeated introductions of chloride of lime solution when required.

Direct Production of Fine Copper from its Ore.—A German patent has been granted to Borchers, Franke and Günther for a process of obtaining fine copper in one operation by electrolysis in an acid sulphate solution. Pyrites is first treated by the ordinary converter process till it contains about 80 per cent. of copper. A concentration of 78 per cent. is sufficient, but if the strength is as low as 72 per cent. electrolysis is no longer possible, while a higher degree of concentration cannot be obtained without loss. The material is then cast into plates or other forms suitable for employment as anodes, and submitted to electrolysis with a current density of about 50 amperes per square metre at both electrodes. If the bath is kept in motion in the usual fashion, the loss of potential at ordinary temperatures generally remains less than 1 volt, even when moderately thick layers of sulphur have been

deposited at the anodes. These crusts of sulphur, knocked off the anodes if necessary, may be worked up by dissolving them in appropriate solvents, by melting them, or by oxidising them according to existing methods into sulphuric acid. After recovery of the sulphur, a residue remains which may contain undecomposed sulphides: this is treated like the anode slime of copper refining to obtain copper sulphate and the noble metals. Any nickel in the pyrites passes into solution, and may be removed when sufficient has accumulated.

Electrolytic Production of Boron.—An American patent has been obtained by Lyons & Broadwell, of Chicago, for a process of electrolysing a molten borate with an anode of carbon or other material capable of reducing boric anhydride. The current density is kept somewhat high at the anode, so that much heating is produced; the oxide being thus reduced to the elemental state.

Patent Acts.—Our attention has again been called by Mr. C. Crossley, of 9, Zenobia Mansions, W., to the fact that a Bill is before Parliament which, if it becomes law, will compel inventors to have recourse to the assistance of patent agents when filing applications for patents. We have previously expressed the opinion that any such restriction would have most unfortunate results, and we have pleasure in supporting the appeal for opposition to it on the part of Mr. Crossley, who will be pleased to hear from any who are interested in the matter.

Willans-Parsons Turbine.—Too late for correction in the article on this turbine, we are informed that the largest size manufactured by Messrs. Willans & Robinson is 5,000 KW., not 3,000 KW.

Appointments Vacant.—Junior switchboard attendant and jointer for Kettering; assistant borough electrical engineer for Poplar (£200); chief assistant for Battersea electricity works; telegraph inspector (£210) for Northern Nigeria; engineer fitter for Camberwell Infirmary (45s.).

Municipal Electric Wiring.—The L.C.C. (General Powers) Bill was before a House of Commons Committee on Wednesday, and the clauses authorising municipal wiring and fitting, &c., were passed. The Committee, however, altered the clauses in order to make it certain that no loss shall fall on the rates, and that provision shall be made for interest and sinking fund charges, but it would not compel the Councils to do the work through contractors.

OUR PERSONAL COLUMN.

[*The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* ELECTRICAL REVIEW *posted as to their movements.*]

Central Station Engineers.—The second annual picnic of the St. Anne's-on-the-Sea Electricity Department took place on May 16th. The staff, their wives and sweethearts, accompanied by the chairman of the Council, Mr. G. W. SPRING, and the chief engineer, Mr. J. H. CLOTHIER, journeyed to Ingleton, where a most enjoyable day was spent. All arrangements were made by Mr. J. C. FAIRCHILD, assistant engineer.

Mr. ROBERT BIRKETT, electrical engineer to the Burnley Corporation, last week tendered his resignation. He has been appointed electrical engineer and general manager of the tramways at Southend-on-Sea; 100 applications were sent in for the appointment.

The Marylebone Borough Council has engaged Mr. T. H. RICHARDSON, of Deptford, as superintendent of the generating station.

The Brighton T.C. on May 18th confirmed the recommendation of the Lighting Committee to increase the salary of Mr. JOHN CHRISTIE, mentioned in our last issue.

The Erith U.D.C. has increased the salary of Mr. G. E. HEATH, resident electrical engineer, from £200 to £250 per annum.

The Mirfield U.D.C., which is taking current in bulk from the Yorkshire Power Co., has appointed Mr. JOHN LOMAS, of Bridlington, as electrician.

The staff of the Middlesbrough Corporation Electricity Works held their third annual dinner on 17th inst. During the evening the mains superintendent, Mr. R. H. SCOTSON, was presented by the staff with a canteen of cutlery on the occasion of his marriage. After dinner a smoking concert was held.

Tramway Officials.—Mr. WILLIAM BAIN has been appointed manager and engineer of the Musselburgh electric tramway undertaking. Mr. Bain acted as constructional engineer, and later as interim manager and engineer.

Mr. A. W. KIRTON has resigned his position as manager of the Corporation tramways at Keighley.

General.—Mr. Dettmer Osmers, of 7, Savage Gardens, Crutched Friars, E.C., has appointed Mr. PAUL WIEDER, who has been with him for some time, as his London representative. Mr. Paul Wieck has left Mr. Osmers' employ.

Mr. J. T. YULE has been appointed chief electrician to Ayr District Asylum.

NEW COMPANIES REGISTERED.

British and Colonial Zoelly Turbine Syndicate, Ltd. (84,598).—This company was registered in May 16th, with a capital of £20,000 in £1 shares, to adopt an agreement between H. Zoelly, of the first part, the Actien Gesellschaft der Maschinenfabriken von Escher, Wyss & Co., of the second part, Mather & Platt, Ltd., of the third part, A. G. Schiff & Co. of the fourth part, and C. H. Whittington (for the company) of the fifth part, and to carry on the business of mechanical, electrical and hydraulic engineers, manufacturers of and dealers in steam turbines and other machinery, &c. No initial public issue. The number of directors is not to be less than three nor more than five; the first are C. Von Gonzenbach (Escher, Wyss & Co.), Zurich; E. Hopkinson (Mather & Platt, Ltd.), Queen Anne's Chambers, Westminster; and K. Schauer (A. G. Schiff & Co.), Warnford Court, E.C.; qualification, 200 shares; remuneration as fixed by the company. Registered office, Queen Anne's Chambers, Westminster.

S. M. H. Tramway Syndicate, Ltd. (84,617).—This company was registered on May 17th, with a capital of £1,000 in £1 shares, to apply to Parliament or other authority for powers to construct light railways or tramways in Durham, to equip, maintain and work the same by means of electrical, steam, animal or other power, and to carry on the business of tramway, railway, omnibus, motor-car, van and mechanical carriage proprietors, suppliers of electricity for power and light, &c. The first subscribers (each with one share) are:—A. H. Drew, 23, Austin Friars, E.C., gentleman; H. R. Hogg, 13, St. Helen's Place, E.C., gentleman; S. A. Chambers, 13, St. Helen's Place, E.C., mechanical engineer; H. Harper, 75, Cannon Hill, N.W., civil engineer; C. Whensa-Nicholl, 18, Compton Road, Winchmore Hill, N., electrical engineer; W. Buchanen, 84A, Ormiston Road, Shepherd's Bush, W., draughtsman; and W. H. Priestley, 23, Austin Friars, E.C., secretary. No initial public issue. The subscribers are to appoint the first directors; remuneration, £50 each per annum (chairman, £75). Registered office, 13, St. Helen's Place, E.C.

Scottish Electro-Medical Institute, Ltd. (5,888).—This company was registered in Edinburgh on May 18th, with a capital of £1,000 in £1 shares, to carry on the electro-medical treatment of human ailments. The first subscribers (each with one share) are:—J. Glover, 7, Buchanan Terrace, Paisley, manufacturer; W. Wilson, 21, Oakshaw Street, Paisley, clerk; W. Lurcan, 52, St. Enoch Square, Cardiff, merchant; J. L. Mackay, 24, Blytheswood Square, Glasgow, solicitor; J. H. Young, 22, Renfield Street, Glasgow, chartered accountant; F. Lee, 7, India Street, Glasgow, electrician; and R. W. Reid, 24, Blytheswood Square, Glasgow, cashier. The number of directors is not to be less than three nor more than five; the first are J. Glover, W. Wilson, W. H. Turcan, and J. L. Mackay. Registered office, 24, Blytheswood Square, Glasgow.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

General Electric Tramways Co., Ltd. (43,428).—This company's annual return was filed on May 4th, when the entire capital of £18,500 in £1 shares had been taken up and paid in full. Mortgages and charges: £15,000.

Hartlepool Electric Tramways Co., Ltd. (49,734).—This company's annual return was filed on May 4th, when the entire capital of £100,000 in 5,000 ordinary and 5,000 preference shares of £10 each had been taken up and paid in full. Mortgages and charges: £50,000.

British Electric Traction Co., Ltd. (49,855).—Particulars of a series of debentures created by resolution of June 16th, 1898, securing an amount equal to half the subscribed capital for the time being, have been filed in accordance with Sec. 14 (4) of the Companies' Act, 1900, a debenture of recent date having been produced at the time of filing. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees for debenture holders. A letter annexed to the return states that these debentures are issued to trustees for holders of debenture stock of like amount, acting under a trust deed, dated June 30th, 1898, as modified by a deed of October 6th, 1898, and that some debentures of this series have already been registered. The trustees for the debenture stockholders are the Electric and General Investment Co., Ltd.

Indian Electric Supply and Traction Co., Ltd. (84,233).—A charge, dated May 4th, 1905, to secure the amount to be expended on or in relation to the company's Cawnpore undertaking (being supplemental to a deed of April 20th, 1905, covering £125,000 debenture stock), has been registered. Property charged: The company's Cawnpore undertaking—such charge to merge in the Indian mortgage on the said undertaking when created. Trustees: F. L. Harris, M.P., 4, Green Street, W.; and E. E. Bird, 58, Cadogan Place, S.W.

G. E. Lancelott, Ltd., electrical and general engineers, Birmingham (84,211).—£3,000 debentures, dated May 15th, 1905, charged on the company's undertaking and property, present and future, including uncalled capital, have been registered. No trustees. Holder: G. E. Lancelott, Soho Avenue, Handsworth.

W. R. Sykes Interlocking Signal Co., Ltd., Clapham (62,522).—A memorandum of satisfaction in full of a charge dated September 20th, 1904, securing £5,000, has been filed.

C. & A. Musker (1901), Ltd., electrical and general engineers, Liverpool (70,573).—Particulars of £20,000 debentures, created by resolution of May 10th, 1905, have been filed pursuant to Sec. 14 (4) of the Companies' Act, 1900. Property charged: The company's undertaking and property, present and future, including uncalled capital (if any), subject to an authorised series of £50,000 first mortgage debentures (of which £44,000 have been issued). No trustees.

National Electric Construction Co., Ltd. (53,364).—A memorandum of satisfaction in full of a charge dated August 4th, 1904, securing £20,000, has been filed.

Dulverton Electric Lighting Co., Ltd. (80,071).—A mortgage dated May 9th, 1905, to secure £150, charged on fixed plant and machinery at the Electric Lighting Station, Dulverton, and the company's other assets has been registered. Holder: F. Moore, Mollond, Devon.

Chislehurst Electric Supply Co., Ltd. (50,980).—This company's annual return was filed on April 28th, when the entire capital of £15,000 in 3,000 ordinary shares of £5 each has been taken up. £5 per share has been called up, resulting in the receipt of £14,908. £92 remains in arrears. Mortgages and charges: £5,000.

W. E. Dove & Co., Ltd., Electrical Engineers, Darlington.—Particulars of £1,000 debentures, created April 3rd, 1905, charged on the whole of the company's property, including plant, stock, uncalled capital and book debts, have been filed pursuant to Section 14 (4) of the Companies' Act, 1900. No trustees.

This company's annual return, made up to April 17th, was filed on May 5th, when 235 shares had been taken up out of a nominal capital of £2,500 in 250 shares of £10 each. £10 per share has been called up on 115 shares, resulting in the receipt of £1,150. 120 shares are considered as fully paid. Mortgages and charges: Nil.

National Telephone Co., Ltd. (15,066).—This company's annual return to March 14th was filed on April 3rd. The capital is £6,000,000 in 15,000 first and 15,000 second preference shares of £10 each, 250,000 third preference and 100,000 ordinary shares of £5 each, £1,983,333 6s. 8d. preferred stock and £1,966,666 13s. 4d. deferred stock, of which all the first, second and third preference shares, and preferred and deferred stock have been taken up. £10 per share has been called up on 12,220 first preference and 15,000 second preference and £5 per share on 221,716 third preference shares, and the full amount on £1,264,660 preferred and £529,320 deferred stock. £3,174,760 has been received. £2,325,240 is considered as paid on 2,780 first and 28,284 third preference shares and £718,673 6s. 8d. preferred and £1,457,346 13s. 4d. deferred stock. Mortgages and charges: £3,689,593.

Auto-Electric Rifle and Target Co., Ltd. (76,336).—Issue, on April 28th, of £100 debentures, part of series created December 5th, 1904, to secure £5,000, charged on the company's undertaking and property, present and future. No trustees. Previously issued of same series: £2,800.

St. Austell and District Electric Lighting and Power Co., Ltd. (66,382).—This company's annual return, made up to December 31st, 1904, was filed on May 15th, 1905, when 2,000 shares had been taken up out of a nominal capital of £10,000 in £1 shares. £1 per share has been called up, resulting in the receipt of £1,870. £130 remains in arrears. Mortgages and charges: £500.

Harry W. Cox, Ltd., electricians, London.—£2,000 "B" debentures, created and dated May 9th, 1905, charged on the company's property, present and future, have been registered. No trustees.

CITY NOTES.

Electric Lighting and Traction Co. of Australia.

Mr. J. B. Braithwaite, jun., presided at the annual meeting of the company, held at Winchester House on Monday. He moved the adoption of the report of the directors for the financial year ended August 31st, 1904. It showed that during the year capital expenditure in Australia on buildings, plant, and mains had been incurred as follows:—On the Melbourne undertaking, £4,776; on the Adelaide undertaking, £6,191; on the Geelong undertaking, £2,775; total, £13,722. The profits derived from the company's undertakings in Australia amounted to £10,971, as compared with £6,249 during the previous year. Management and general expenses at the London head office amounted to £2,056, and debenture and bank interest to £11,022. After payment of these charges, and writing off repairs and renewals incurred during the year, and also a loss of £252 on the Port Adelaide undertaking, there was a balance to the debit of profit and loss account of £4,667, as compared with £7,422 last year. The breaking up of the prolonged drought in Australia, and the consequent improvement in the general prosperity of the country, have reacted favourably upon the company's business, and the aggregate number of lamps connected to the mains has increased satisfactorily, thus:—

Station.	Total equivalent connections in 8-c.p. lamps. August 31st, 1903.	August 31st, 1904.
Melbourne	37,084	48,692
Adelaide	33,994	55,516
Geelong	13,462	19,938
Port Adelaide	5,204	6,086
Totals	89,644	130,232

The advantages of electricity for motive power are becoming increasingly recognised, and there is a growing demand for power supply at all the stations. On August 31st, 1904, there were 521 motors, equivalent to 1,418 H.P., connected to the mains, and a further 231 H.P. has been connected during the first six months of the current financial year. The unremitting efforts that continue to be made to increase the company's revenue and reduce the working expenses, are meeting with good success; and the directors desire to express their appreciation of the ability and devotion to the company's interests of their engineer and manager, Mr. F. W. Clements, and his staff in Australia.

Melbourne.—This station has made marked progress during the year, the total lamp connections having increased by 31 per cent., while the cost per unit sold shows a reduction of 2½ per cent., as compared with the previous year. The financial result is a gross profit of £4,764 12s. 4d., which compares with £2,093 16s. 3d. last year. The provision of additional generating plant will shortly be necessary in order to keep pace with the rapidly increasing demand for light and power.

Geelong.—The normal operation of this station has been somewhat interfered with during the past year by the unexpected breakdown of the storage battery, necessitating the immediate shipment of a new battery of another type, which is now working satisfactorily; the cost of the replacement, amounting to £1,800 2s. 8d. will be written off out of the profits of the station over a term of five years. The past year's profit and loss account, after being debited with one-fifth of the cost of the new battery, shows a gross profit of £852 18s. 10d.; the lamp connections have increased by 48 per cent.; and the cost per unit sold as been reduced by 22 per cent. Electric motive power is largely used at Geelong in connection with the forage-pressing industry, and on the wharves for the loading of vessels; and in order to cope with the steadily increasing load, additional generating plant of 800 KW. capacity has recently been shipped.

Adelaide.—This station also continues to make excellent progress, the financial result for the past, its third, year of working, being a gross profit of £5,373 16s. 8d., as compared with £3,449 18s. 7d. for the previous year. The lamp connections have increased by 46 per cent. during the year, and a reduction of 12 per cent. has been effected in the cost per unit sold.

Port Adelaide.—The working of this station during the past year shows a loss of £252 9s. 11d., which points to the advisability of closing it down and supplying the district from Adelaide.

The South Australian Undertakings.—The directors having decided that it was in the best interests of the company, in view of possible developments, that the South Australian undertakings should be separated from the rest of the company's business, the Adelaide Electric Supply Co., Ltd., was accordingly formed last month with a capital of £800,000, divided into 30,000 6 per cent. cumulative preference shares of £5 each, and 90,000 ordinary shares of £5 each; and the undertakings at Adelaide and Port Adelaide have been transferred to the new company in consideration of a purchase price of £162,500, payable as to £127,500 in ordinary shares, and as to the balance of £35,000 in cash. The Adelaide Co. takes over the business as from the 1st September, 1904, being the commencement of the current financial year; this company thus receives for its capital expenditure of £115,570 15s. 3d. on the South Australian undertakings, £127,500 in ordinary shares of the new company, together with a sum of £35,000 in cash, which will furnish the necessary funds for the further development of the undertakings at Melbourne and Geelong. It is believed that the prospects generally of the undertakings will be materially improved by their establishment upon a local basis; and inasmuch as this company will continue to share in the profits of the Adelaide business through its large holding of ordinary shares in the new company, the directors are confident that the important step they have thus taken will prove to be in the best interests of the shareholders of this company.

The Chairman said that there was little to add to what appeared in the report, as it contained practically all the information that they had to give. He said that the profits of the combined undertakings showed an increase of between 60 per cent. and 70 per cent. on the previous year's figure. Analysing the separate stations, it was very significant and encouraging to find that on this occasion Melbourne headed the list. Some of the company's difficulties in the past had been due to the relatively slow growth of business in the Melbourne suburbs. During this year Melbourne had more than doubled its profits. In view of the fact that they had always looked to Melbourne as the ultimate backbone of the business, that was a distinctly encouraging feature. Geelong had done considerably better this year, and was showing a small profit. In every one of the three stations the result had shown a considerable increase in revenue, and a substantial decrease in the cost of manufacture. Since the date of the report, the rate of progress had continued in a satisfactory manner. In regard to the South Australian undertakings the result of the change mentioned in the report was that for their expenditure of £115,000 on the Adelaide undertaking, this company received £127,500 in ordinary shares, and £35,000 in cash, so that they still retained their interest in the company almost undiminished. The £35,000 would be employed as occasion required in the development of the Melbourne and Geelong undertakings. After briefly running over some of the items in the balance-sheet, the chairman said that the future outlook was in the direction of further steady improvement in the position of the company. The returns received for the first six months of the financial year, which were the six summer months, showed a profit rather more than double what it was for the same period last year. They could hardly expect the winter profits to double. He then proceeded to refer to the general Australian outlook, and quoted from an article in the *Financial Times*, which seemed to indicate that the business depression which followed on the long and severe drought, was now passing away, and as people found that they had more money to handle, they would be more ready to wire their houses and premises.

Mr. R. Percy Sellon seconded the motion, and it was adopted.

Mr. J. F. Albright was re-elected a director. The auditors were re-elected.

Elmore's German and Austro-Hungarian Metal Co.

Mr. John McFarlan presided at the annual meeting held at Winchester House last Friday, and in moving the adoption of the report (see Electrical Review, May 12th, p. 781), he said that although they were compelled to admit that they were disappointed with the actual result they believed the anxieties of the past were to be repaid, and that the company would again be in a dividend-earning stage within a measurable length of time. With regard to the accounts of the Austrian company, debenture interest still pressed most hardly—so much so that were the capital employed in the company wholly share capital, they could have regularly paid dividends—and even this year a dividend of 2¾ per cent. could have been paid on the whole of the capital employed. The accounts of the Metall Co. showed a marked improvement all round. The gross profit was over 20 per cent. greater than that made in 1903, while the net profit was 73 per cent. better. This result had been effected partly by a reduced cost of production and general economy, and partly by better prices being obtained. The usual depreciation had been written off, the sum of M.7,195.46 has been placed to reserve, bringing the fund to M.20,757.00, and a dividend of 11 per cent. had been declared, and at the same time the heavy charges for interest, &c., mentioned in the report, had been duly met. The expenditure during the year had been considerable. Over £10,000 had been spent on new plant. The directors' anticipations that the new machine would be at work at an early date were not realised, for the year was a busy one for Germany, and delivery of the fly-wheel and other adjuncts to the machine, which had to be made in Germany, was not obtained till some months after the promised date, and when all was in working order a flaw developed which necessitated replacing an integral portion of the machine. Still further delay was thus caused, and it was not until the end of the year that the machine was in good working order. The directors had seen the machine at work, and so far were gratified with the results, but experience had still to be gained, which, when acquired, would doubtless result in a still further reduction in the cost of production. The installation of this machine had had a double effect, for while itenabled them to

produce small diameter tubes more rapidly and at an increased profit, it had thrown those tanks which were occupied in producing the lowest priced tubes free for the better paying class of work. Apart from the new machine, it was satisfactory to know that the cost of production by the electrolytic process had been still further reduced. In the four months since January 1st last, there had been a considerable increase in the output, sales, and the price received for goods. Owing to the large demand of the home trade they had been able to reduce the sale of low-priced tubes for the export trade, with the result that the difference between the price of raw copper and the price at which they sold goods, had been increased, and from the orders in hand it would certainly appear that such increase would be maintained for some time. In consequence of the formation of a syndicate, referred to in the report, a saving in the cost of management was probable, so that taking everything into account, especially the reduction of the cost of production, due to the new machine, they believed that the results of this year would be better than those for 1904.

Mr. J. Heal seconded the motion, which was adopted.

Castner-Kellner Alkali Co.

Sir Henry Roscoe presided at this company's meeting held at Cannon Street Hotel on 18th inst., and in moving the adoption of the report (Electrical Review, May 19th, p. 882), he said that the net profits were £10,000 more than in the previous year. Their available balance was £54,001 after paying debenture interest. They were allocating as usual £15,000 to depreciation reserve account, which now amounted to £85,000, and they proposed to write a further £8,204 off plant, patents, and suspense account. After paying the 4 per cent. dividend, £12,799 remained to carry forward, a much larger sum than last year. The company had experienced a good demand for its products during the year and prices had slightly advanced, but the increased profits were due to improved methods of working more than to advanced prices. The work of substituting gas engines for steam had now been finished and the price of power had been reduced. The report was adopted.

Worcester Electric Traction Co.

Mr H. S. Day presided at this company's meeting and proposed the adoption of the report which was abstracted in our issue of May 12th, p. 782. He said that the major portion of the line was opened on February 6th. The revenue from the cars was £11,640, and the amount of expenditure £6,308, giving a profit of £5,332. With the 'buses the revenue was £3,970, the expenditure £4,134, and the net revenue loss £164. In 1903 no repairs were able to be carried out—consequent on the electrification of the line—and it was necessary, in the autumn of 1904, to spend quite a large sum in bringing the 'buses up to a proper condition. In view of the fact that the profit represented the result of an incomplete year's working, the directors viewed the result with satisfaction. The cars carried 2,839,182 passengers and the 'buses 263,170. The average receipts per passenger for the cars were ·98d., and for the 'buses 3·62d. The expenditure per passenger on the cars was ·53d., and on the 'buses 3·77d. The directors were apprehensive of laying out any further capital pending a more intimate knowledge of the development of traffic outside the city boundary. They had carefully watched the development of the motor-'bus, but so far they were not convinced that one suitable for the roads at Worcester could be obtained at a reasonable price and show a net revenue which would be satisfactory to the company. The report was adopted and the dividend approved.

Stock Exchange Notices.—The Committee has appointed a special settling day as under:—

Wednesday, May 31st.—Charing Cross, Euston and Hampstead Railway Co.—Speyer Brothers' scrip certificates (fully and partly paid) for £800,000 4 per cent. perpetual debenture stock. Great Northern, Piccadilly and Brompton Railway Co.—Speyer Brothers' scrip certificates (fully and partly paid) for £1,200,000 4 per cent. perpetual debenture stock.

And has ordered same to be quoted in the Official List, as well as

Baker Street and Waterloo Railway Co.—£500 perpetual 4 per cent. debenture stock, in lieu of the Speyer Brothers' scrip certificates now quoted.

Application has been made to the Committee to allow the following to be quoted in Official List:—British Westinghouse Electric and Manufacturing Co., Ltd.—further issue of £400,000 4 per cent. mortgage debenture stock.

Oriental Telephone & Electric Co.—An extraordinary general meeting of this company is to be held at the Abercorn Rooms, Great Eastern Hotel, E.C., on Wednesday, May 31st, at one o'clock p.m., to consider a resolution empowering the directors to create debenture stock to the extent of £200,000, and to issue the same from time to time as they may deem expedient, and on such terms as to rate of interest, security and otherwise as they may think fit. As was explained by the chairman at the last annual general meeting, this further capital has become necessary to provide for the reconstruction and extension of the company's installations to comply with the requirements of the Governments of India, the Straits Settlements and Hong Kong, and for the development of the growing business of the company and the companies associated with it.

STOCKS AND SHARES.

Wednesday Evening.

Renewed talk of the possibilities of money becoming cheaper has put rather more heart into prices, although business remains exceedingly restful. The end of a 19-day account is at hand, and although the mid-June settlement will be broken by the Whitsun holidays, it holds out perhaps a little more hope for Stock Exchange animation than that now current. Our records of prices are tame in their narrowness of fluctuation; the lack of movement adequately reflects the quietude of trade throughout the markets.

Electric lighting issues survey with equanimity the proceedings in connection with the new London Power scheme. The fall that occurred in a few prominent Metropolitan shares before the Commission commenced its sittings has been partially recovered, and the market professes to have little fear of what subsequent developments may arise. It is of interest to electric lighting shareholders to indicate the sharp rise just scored by the Ordinary stock of the Gas Light and Coke Co. upon the assumption that some agreement will perhaps be come to for the substitution of gas in certain London thoroughfares in place of the electric light now used.

Of the changes in this department, the only noticeable ones are ⅛ rise in Urban Preference, to 5¼, and ¼ fall in London Electrics to 2¼. A point rise in County of London Second Debenture makes the price 104. Edison & Swan "A" are a better market at 1⅜, but Electric Constructions dropped ¼ to 1. Babcock & Wilcox have settled down to 5¼, and the Preference shares are still 30s.

Coming issues include one of Debenture stock by the Oriental Telephone Co, the proprietors having been summoned to meet next Wednesday, May 31st, to pass a resolution empowering the directors to create £200,000 Debenture stock. In underwriting circles there has already been discussion as to what terms the company would have to offer in order to get half this amount placed. Possibly a 4½ per cent. stock issued about 98 would command success, but much naturally depends upon the monetary conditions existing at the time that the stock is offered. The prices of the Ordinary shares have receded $\frac{1}{16}$ to 1¼, while the National Telephone septet is steady. Lord Stanley promises that the House of Commons shall have opportunity for considering the Telephone Agreement before the end of August. Herein lurk fine possibilities for more Parliamentary rowdyism.

Another series of sharp falls in West India and Panama descriptions is the feature in the Telegraph market. The Second Preference have again proved the most vulnerable, and a fresh fall of 25s. makes a loss of £2 in a fortnight. The middle price is now 6, and the dealers are not at all eager to quote close prices. As we mentioned last week, the drop is due to what is considered a disappointing dividend declaration; but admitting that better things were expected, the fall seems to have discounted the disappointment pretty fully, and some reaction would not be surprising. The First Preference at 7½ are ½ down, and the Ordinary shed $\frac{1}{16}$ to $\frac{9}{16}$. No improvement has occurred in the Eastern groups, and Cuba Telegraphs fell ¼ to 8¼. Anglo-Americans are also lower upon the contraction of business in the Yankee Railroad section, but Amazon Debentures continue to forge ahead, their rise of a point bringing the price to 77½. Submarine Cables Trusts are a shade firmer. Globes display no change. Telegraph Constructions fell another sovereign to 34.

Investment demand shuns the Home Railway market, and the electric varieties are mostly lower, Central London Deferred having dropped 2 to 81½, and the Ordinary losing its slight rise of last week. City and South London is also dull at 41, and Districts drooped to 37½, although Metropolitan Consolidated is steady at 93½. The Military Tournament may do the first-mentioned company some good: its traffics are certainly poor enough at present. Impatient travellers on the District sarcastically refer to the electrification of the line as a second Mrs. Harris. Against the better traffics likely to accrue by reason of a capital Earl's Court Exhibition there must be set the County Council's obstinate determination to obtain powers to run trams along the Embankment.

Some of the Traction descriptions are a shade better. British Electrics of both kinds show a slight improvement, and Barcelonas rose ⅛ to 11⅛. Cape Electrics at 1⅛ have not altered on the result of the meeting, and London United Preference remain at 10. Anglo-Argentine Ordinary are 8⅜, the Preference 6, while Belgrano at 3½ are also motionless.

Cape Electric Tramways, Ltd.—This company held an extraordinary general meeting on Tuesday, and passed a resolution instructing the directors not to purchase the tramways of the Cape Town Consolidated Tramways and Land Co. nor to renew the lease. Mr. Ludwig Breitmeyer was in the chair. The resolution was seconded by Mr. A. W. Parrish.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1902.	1903.	1904.	Closing Quotations May 17th.	Closing Quotations May 24th.	Business done week ended May 24th, 1905. Highest	Lowest
34,800	African Direct Telegraph, 4 % Debs.	100	4 %	4 %	4 %	99 —102	99 —102	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	2¼ — 2⅜	2¼ — 2⅜	..	..
119,700‡	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	Nil	Nil	Nil	74 — 79	75 — 80	..	..
765,580	Anglo-American Telegraph	Stock	60/6	61s.	28/6	59 — 61	59 — 61	59½	..
3,118,210	Do. do. do. 6 % Pref.	Stock	6 %	6 %	5½%	105½—106½	105 —106	106½	105½
3,118,210	Do. do. do. Deferred	Stock	1/-	2s.	Nil	15½— 15⅝	15⅜— 15⅝	15⅝	15⅜
44,000	Chili Telephone, Nos. 1 to 44,000	5	6 %	7 %	..	6⅝— 6¾	6⅝— 6¾	..	..
15,000,000$	Commercial Cable	$100	8 %	8 %	8 %	230 —240	230 —240	..	..
1,932,856‡	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	4 %	4 %	4 %	97 — 99	97 — 99	98½	98
16,000	Cuba Telegraph	10	6¾%	5 %	5 %	8¼— 8¾	8 — 8¼	8⅛	..
6,000	Do. 10 % Pref.	10	10%	10%	10%	15 — 16	15 — 16	..	..
12,981	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	3⅜— 3⅝	3⅜— 3⅝	..	..
6,000	Do. do. 10 % Cum. Pref.	5	10%	10%	10%	8¾— 9	8¾— 9	..	..
80,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	101 —103⅜	101 — 103	103	..
80,710‡	Direct United States Cable	20	3⅛%	3 %	..	11¼— 11½	11¼— 11½	..	..
75,500	Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,900, Red.	100	4½%	4½%	4½%	100 —102	100 —102	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	..	139 —142	139 —142	141	139
2,000,000	Do. 3½ % Pref. Stock	100	3½%	3½%	..	91 — 93	91 — 93	91⅝	91½
1,896,814	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	4 %	107 —109	107 —109	108½	108
600,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	14 —14½	14½— 14⅝	14½	14⅜
602,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	105 —107	105 —107	106½	..
800,000	Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 8,000, red. 1909	100	4 %	4 %	4 %	100 —102	100 —102	..	..
200,000‡	Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	100 —102	99 —101	..	..
180,887	Globe Telegraph and Trust	10	£3 16 7*	5½%	5⅜%	10½— 10⅝	10½— 10⅝	10⅝	10½
180,687	Do. 6 % Pref.	10	6 %	6 %	6 %	14¾— 15	14¾— 15	15	14⅞
160,000	Great Northern Telegraph, of Copenhagen	10	12½%	15 %	24 %	34 — 35	34 — 35	34	..
60,600	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	100 —102	100 —102	..	..
17,000	Indo-European Telegraph	25	10%	10 %	13 %	50 — 52	50 — 52	..	..
72,680	Monte Video Telephone Co., Ltd., Ord.	1	3 %	3 %	..	⅜— ⅞	⅜— ⅞	..	..
1,988,888	National Telephone, Pref. Stock	100	6 %	6 %	6 %	108¾ —109½	109 —110	110	108½
1,966,667	Do. do. Def. Stock	100	4½ %	5 %	5 %	101 — 103	101 —103	102½	102
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	12½ — 12⅝	12⅝— 13⅛	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	11⅝ — 12⅛	11⅝— 12⅛	..	..
250,000	Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000	5	5 %	5 %	5 %	5⅜— 5⅝	5⅜— 5⅝	5⅛	5 1/16
9,000,000	Do. do. 3½ % Deb. Stock Red.	Stock	3½ %	3½ %	3½%	100 —102	100 —102	100⅝	..
1,689,593	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	103¼—105½	103 —105	104⅜	103½
179,318	Oriental Telephone and Elec. Nos. 1 to 171,504, fully paid	1	6 %	6¼%	6¼%	1⅛— 1 3/16 xd	1 1/16— 1 1/16 xd	1 1/16	1⅛
50,000	Do. do. 6 % Cum. Pref.	1	6 %	6 %	6 %	1⅛— 1⅛	1⅛— 1⅛ xd	..	..
100,000	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	4 %	99 —102	99 —102	..	..
11,889‡	Reuter's	8	5 %	5 %	5 %	7⅞— 8¼	7⅞— 8¼	..	..
8,287	Submarine Cables Trust	Certs.	6 %	6 %	6 %	122 —125	123 —126	..	..
58,000	United River Plate Telephone	5	7 %	8 %	..	6⅞— 7¼	6⅞— 7¼	6 1/16	..
40,000	Do. do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	..	5 — 5⅛	5 — 5⅛	..	..
179,947	Do. do. 5 % Debs.	Stock	5 %	5 %	5 %	107 —109	107 —109	..	..
15,600‡	West African Telegraph, Shares	10	2 %	4 %	4½%	8 — 8½	8 — 8½	..	..
30,008	West Coast of America, 1 to 30,000 and 53,001 to 53,008	2½	Nil	Nil	Nil	⅜— ½	⅜— ½	..	..
150,000	West Coast of America, 4% Debs., 1 to 1,500 guar. by Brss. Sub. Tel.	100	4 %	4 %	4 %	100 —102	100 —102	..	..
207,990	Western Telegraph, Ltd., Nos. 1 to 207,990	10	7 %	7 %	7 %	13½— 14	13½— 14	13 1/16	13⅜
75,000	Do. do. 5 % Debs. 2nd series, 1906	100	5 %	5 %	5 %	101 —103	101 —103	..	..
558,880	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	103 —105	103 —105	..	..
38,321	West India and Panama Telegraph	10	Nil	Nil	Nil	3/16— ⅜	⅛— ⅜	..	..
34,553	Do. do. do. 6 % Cum. 1st Pref.	10	7 %	7 %	6 %	7½— 8⅛	7½— 7⅝	7⅝	7½
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	7 — 7½	5½— 6⅛	6½	5½
80,000‡	Do. do. do. 5 % Debs., Nos. 1 to 1,600	100	5 %	5 %	5 %	104 —106	104 —106	..	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

43,000	British Aluminium 7 % Cum. Pref.	5	Nil	Nil	Nil	5 — 5⅛	5 — 5⅛	..	..
40,000	Do. do. "A" 6 % Cum. Pref.	5	Nil	Nil	Nil	4⅜— 5⅛	4⅜— 5⅛	..	..
20,000	Do. do. 4% Funding Certs.	5	..	..	..	2⅜— 3⅛	2⅜— 3⅛	..	..
800,000‡	Do. do. 5% 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	98 —102	98 —102	..	..
133,301	British Electric Traction	10	8 %	6 %	..	9⅛— 9⅜	9⅛— 9⅜	9⅛	9 1/16
156,437	Do. do 6 % Cum. Pref.	10	6 %	6 %	..	10⅜— 11⅛	10⅜— 11⅜	11⅛	11⅛
1,000,000‡	Do. do. 5 % Perpetual Debenture Stock	Stock	5 %	5 %	5 %	121 —123	121 —123	122⅞	12·½
250,000	Do. do. 4½% 2nd Deb. Stock Red.	100	..	..	4½%	96 — 98 xd	97 — 99	98½	97½
100,000	British Insulated and Helsby Cables	5	10 %	8 %	8 %	5⅛— 6	5⅛— 6	..	..
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	5⅛— 6	5⅛— 6	..	..
500,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	4½%	4½%	4½%	102 —105	102 —105	..	..
50,000	¶Brownett, Lindley & Co., Ord.	£1	Nil	Nil	Nil	9/16— 11/16	9/16— 11/16	..	..
50,000	¶ Do. do. 6 % Cum. Pref.	£1	Nil	Nil	Nil	14/6 to 15/6	14/6 to 15/6	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731	2	Nil	Nil	Nil	½— ¾	½— ¾	..	..
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	6 %	6 %	1⅝— 2	1⅝— 1¾xd	..	..
125,000‡	Do. do. 4½ % Perp. Deb. Stock	Stock	4½%	4½%	4½%	92 — 95	92 — 95	..	..
125,000‡	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	4½%	4½%	4½%	79 — 82	79 — 82	..	..
85,000	Callender's Cable Construction shares	5	15 %	12½%	12½%	10½— 11½	10½— 11½	11½	11½
40,000	Do. do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5⅛— 5⅜	5⅛— 5⅜	..	..
800,000	Do. do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	107 —109	107 —109	..	..
1,963,208	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	92 — 94	91 — 93	92½	91⅝
523,396	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	101—103	101 —103	101½	..
523,396	Do. do. Def. do.	Stock	4 %	4 %	4 %	82 — 85	80 — 83	..	..
1,800,000	City and South London Railway	Stock	3½%	2¾%	2½%	42 — 43	40 — 42	41⅞	40⅛
85,000	Crompton & Co., Nos. 1 to 85,000	5	5 %	2½%	..	2 — 2⅛	1⅞— 2⅛	2	..
100,000‡	Do. 5 % 1st Mort. Reg. Debs., to 900 of £100, and 901 to 11,000 of £50 red.	..	5 %	5 %	5 %	95 —100	95 —100	..	..
99,361	Edison & Swan United Elec. Light, "A" shares, £8 paid, 1 to 99,361	5	Nil	Nil	..	1 — 1⅛	1⅛— 1⅛	1 1/16	1 1/32
17,189	Do. do. "A" shares, 01—017,189	5	Nil	Nil	..	2 — 2⅛	2 — 2⅛	..	..
344,023‡	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	82 — 87	83 — 88	..	..
100,000‡	Do. do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	87 — 92	87 — 92	..	..
112,100	Electric Construction 1 to 112,100	2	6 %	4 %	..	1 — 1⅛	⅞— 1⅛	..	..
81,890	Do. do. 7 % Cum. Pref., 1 to 81,890	2	7 %	7 %	..	2⅛— 2⅜	2⅛— 2⅜	..	..
200,000	Do. do. 4 % Perp. 1st Mort. Deb. Stock	Stock	4 %	4 %	4 %	96 — 99	96 — 99	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	..	9⅜— 10⅛	9⅜— 10⅛	..	..
200,000	Do. do. 4 % Mort. Deb.	Stock	4 %	4 %	4 %	97 —101	97 —101	..	..
200,000	Henley's (W. T.) Telegraph Works, Ord.	5	20 %	15 %	15 %	11¼— 12½	11¼— 12½	..	..
200,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	5⅛— 5⅜	5⅛— 5⅜	5 1/16	..
45,900	Do. do. 4½ Mort. Deb. Stock	Stock	4½%	4½%	4½%	109 —111	109 —111	..	..
60,000	India-Rubber, Gutta-Percha & Telegraph Works	10	10 %	10%	..	16 — 17	15½— 16½	16	..
930,000‡	Do. do. 4 % 1st Mort. Deb.	100	4 %	4 %	4 %	100 —103	100—103	101½	..
87,500	†Liverpool Overhead Railway, Ord.	10	1½%	1⅜%	1½%	3 7/16— 3 9/16	3⅜— 3½	..	..
10,000	† Do. do. Pref. £10 paid	10	5 %	5 %	5 %	9½— 9¾	9½— 9¾	..	..
37,850	Telegraph Construction and Maintenance	12	20 %	20 %	15 %	34 — 36	33 — 35	35½	34
150,000‡	Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909	100	4 %	4 %	4 %	103 —105	103—105	..	..
840,000‡	Waterloo & City Railway, Ord. Stock	100	8½%	8½%	8½%	91 — 93	91 — 93	91½	91

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ From Manchester Share List

Bank rate of discount 2½ per cent. (March 9th, 1905).

SHARE LIST OF ELECTRICAL COMPANIES (*continued*).— ELECTRICITY SUPPLY COMPANIES.

Present issue.	NAME.	Stock or Share.	Dividends for the last three years 1903.	1903.	1904.	Closing Quotations May 17th.	Closing Quotations May 24th.	Business done week ended May 24th. 1905. Highest.	Lowest
£9,877	Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000 ..	£ 5	8 %	10 %	10 %	9¼ — 10½	9⅝ — 10¼	..	..
10,623	Do. do. 7 % Cum. Pref. ..	5	7 %	7 %	7 %	9¼ — 10½	9⅝ — 10¼	10 1/16	9 31/32
£88,782	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	105 —108	105 —108	..	..
80,000	Charing Cross and Strand Electricity Supply	5	10 %	8 %	8 %	7⅞ — 8¼	7⅞ — 8¼	..	..
80,000	Do. do. 4½% Cum. Pref. ..	5	4½%	4½%	4½%	6⅝ — 6⅞	6⅝ — 6⅞	6⅝	..
40,000	Do. do. "City Undertaking" 4½% Cum. Pref. ..	5	4½%	4½%	4½%	4⅞ — 5⅛	4⅞ — 5⅛	..	..
40,000	Do. do. 1903	5	..	4½%	4½%	4⅞ — 5⅛	4⅞ — 5⅛	5 1/16	..
350,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	105 —107	106 —108	..	..
44,486	*Chelsea Electricity Supply, Ord.	5	4¼%	5¼%	6 %	6¼ — 6¾	6¼ — 6¾	6 7/8	6 3/4
150,000£	Do. do. % Deb. Stock Red.	Stock	4½%	4½%	4½%	109 —111	109 —111	..	..
70,595	City of London Electric Lighting, Ord. 40,001—110,595 ..	10	5 %	5 %	6 %	11 — 12	10¾ — 11½	11 7/8	10¾
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	12⅝ — 14¼	12⅝ — 14¼	..	..
400,000£	Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid	..	5 %	5 %	5 %	124 —128	124 —128	..	..
300,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid ..	100	4½%	4½%	4½%	104 —106	104 —106	104	..
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4 %	4 %	4½%	8⅜ — 9½	8⅜ — 9	8⅝	..
80,000	Do. do. do. 6 % Pref., 40,001—80 ..	10	6 %	6 %	6 %	12 — 12½	12 — 12½	12⅝	..
400,000£	Do. do. 4½% Deb. Stock	..	4½%	4½%	4½%	112 —115	112 —115	1 14 1/2	113½
250,000	Do. do. 4½% 2nd Deb. Stock	Stock	4½%	4½%	4½%	102 —104	103 —105	104	103½
70,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	..	5⅝ — 6¼	5⅝ — 6¼	6 1/16	6 5/32
80,000	Do. do. 6 % Cum. Pref.	..	6 %	6 %	..	6 — 6¼	6 — 6¼	..	..
800,000£	Do. do. 4½% 1st Mort. Deb. Stock ..	100	4½%	4½%	4½%	107 —109	107 —109	..	..
21,000	Kensington and Knightsbridge Electric Ord.	5	10 %	12½ %	12 %	12 — 13	12 — 13	..	..
136,000	Do. do. do. 4 % Debenture Stock ..	Stock	4 %	4 %	4 %	101 —103	101 —103	..	..
111,000	London Electric Supply Corporation, Limited, Ord.	3	Nil	Nil	3 %	2½ — 2⅝	2 — 2⅛	2	..
6'0'0	Do. do. do. 6 % Pref.	5	6 %	6 %	6 %	5½ — 5⅝	5 — 5⅛	..	..
371,895	Do. do. do. 4 % 1st Mort. Deb. Stock Red	Stock	4 %	4 %	4 %	99 —101	99 —101	100	..
100,000	Metropolitan Electric Supply, 1 to 100,000	5	7½%	8½%	10 %	.. — ..	9 — 9½	9 5/16	..
76,121	Do. do. 4½% Cum. Pref. 1—71,106, £3 paid ..	5	4½%	4½%	4½%	5½ — 5⅝	5½ — 5⅝	5⅝	..
220,000£	Do. do. 4½% 1st Mort. Deb. Stock	..	4½%	4½%	4½%	109 —114	109 —114	..	..
950,000£	Do. do. 3½% Mort. Deb. Stock Red	Stock	3½%	3½%	3½%	97 — 99	97 — 99	98⅜	98½
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	99 —101	99 —101	100	99½
10,853	Notting Hill Electric Lighting	10	6 %	6 %	7 %	14½ — 15½	14½ — 15½	..	..
59,000	Do. do. 4% 1st Mort. Deb.	100	4 %	4 %	4 %	100 —102	100 —102	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	14 — 15	14 — 15	14	..
20,000	Do. do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7%	7 %	8¼ — 8¾	8¼ — 8¾	..	..
150,000£	Do. do. do. 3½% Deb. Stock Red ..	100	3½%	3½%	3½%	98 —100	98 —100	..	..
12,000	Smithfield Markets Electric Supply, Ord.	5	2½%	4 %	4 %	2⅜ — 3½	2⅜ — 3½	..	..
50,000	Do. do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	79 — 83	79 — 83	..	..
65,000	South London Electricity Supply, Ord.	5	12½%	3 %	4 %	3½ — 4¼	3½ — 4¼	..	..
100,000	South Metropolitan Electric Light and Power (Ord. ..	1	Nil	Nil	Nil	13/16 — 15/16	13/16 — 15/16	..	..
50,000	(*Late Blackheath and Greenwich* 7 % Pref. ..	1	Nil	7 %	7 %	1 5/32 — 1 13/32	1 5/32 — 1 13/32	1⅜	..
100,000	*Dist. E.L.Co.*) 4½% 1st Deb. Stock	100	4½%	4½%	4½%	105 —108	105 —108	..	..
80,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	4⅞ — 5⅛	4⅞ — 5⅛	..	..
80,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 — 5¼	5⅛ — 5⅜	5 5/32	5¼
200,000	Do. do. 4½% 1st Mort. Deb. Stock Red ..	100	..	..	4½%	104 —106	104 —106	105½	..
110,000	Westminster Electric Supply, Ord.	5	12 %	13½%	14%	12 — 13	12 — 13	12½	12
28,151	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	6 — 6½	6 — 6½	6	..

Shares not officially quoted :—Mackay Companies, ord., 39—40. Pref. 73—74.

* Subject to Founders Shares. ‡ Unless otherwise stated all shares are fully paid.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Fort-night ended.	Receipts for the fortnight. £	£*	No. of wks.	Total to date. £	£*	Miles open.	*
Aberdeen	May 20	2,474	— 21	51	66,885	+ 5,417	..	..
Ayr	,, 13	465	+ 46	52	14,796	+ 860	8	..
Bath	,, 17	1,523	+ 385	20	11,955	+ 973	12½	..
Birkenhead	,, 21	1,994	— 92	7	7,377	— 80	13·5	..
Blackburn	..	..	..	..	..	..	13½	..
Blackpool	,, 18	1,199	+ 185	7	4,985	+ 445	8½	..
,, —Fleetw'd	,, 20	710	+ 77	20	5,383	+ 124	..	..
,, —Lytham	,, 18	601	+ 59	29	5,100	..	7½	..
Bolton	,, 21	3,804	+ 263	8	14,268	+ 650	25	..
Bournemouth ..	,, 17	2,119	+ 154	7	7,538	..	10·15	..
Bradford	,, 13	8,284	—1,337	6	26,589	— 307	54	..
Brighton	,, 21	1,875	+ 99	7	6,862	..	9½	..
Bristol	,, 19	9,864	— 29	..	..	..	..	..
Brit. Elec. Trac. Co.								
Airdrie	May 12	391	+ 51	19	3,887	+ 30	..	..
Barnsley	,, 12	297	— 41	,,	2,961	— 5	..	..
Barrow	,, 12	424	+ 137	,,	3,821	+ 876	..	..
Birmingham (City)	,, 12	‡11,350	+ 628	,,	‡104,407	+ 6,532	..	..
Birmingham (Mid.)	,, 12	‡3,591	+ 512	,,	‡33,067	+ 4,779	..	..
Devonport	,, 12	908	— 20	,,	8,392	— 428	..	..
Dudley—Sto'rb'ge	,, 12	1,679	+ 75	,,	15,113	+ 682	..	..
Gateshead	,, 12	1,723	— 20	,,	16,607	+ 4·3	..	..
Gravesend, N'fleet	,, 12	429	— 41	,,	3,793	— 399	..	..
Gr'n'k, Pt. Glsgw	,, 12	1,248	+ 121	,,	10,571	+ 1,506	..	..
Hartlepool ..	,, 12	480	— 61	,,	4,625	— 105	..	..
Kidderminster ..	,, 12	211	— 10	,,	1,844	— 79	..	..
Merthyr	,, 12	382	— 15	,,	3,5·9	— 134	..	..
Metropolitan ..	,, 12	‡4,684	+2,072	,,	‡39,011	+ 16,898	..	..
Middleton	,, 12	640	+ 47	,,	6,487	+ 483	..	..
Oldham — Ashton	,, 12	1,031	— 32	,,	9,192	+ 152	..	..
Peterborough ..	,, 12	264	— 49	,,	2,164	— 156	..	..
Poole	,, 12	585	+ 8	,,	4,664	— 167	..	..
Potteries	,, 12	3,229	— 68	,,	31,177	+ 400	..	..
Rothesay	,, 12	193	+ 24	,,	1,572	+ 85	..	..
Sheerness	,, 10	130	+ 31	,,	1,111	+ 225	..	..
Southport	,, 12	706	— 22	,,	4,·15	— 161	..	..
South Staffs. ..	,, 12	1,334	— 84	,,	12,679	+ 638	..	..
Swansea	,, 12	1,533	+ 554	,,	9,919	+ 1,052	..	..
Taunton	,, 12	101	— 10	,,	830	— 97	..	..
Tynemouth	,, 12	446	— 40	,,	3 558	— 598	..	..
Weston-s-Mare ..	,, 10	192	+ 53	,,	882	+ 127	..	..
Wolverhampton D.	,, 12	702	+ 52	,,	6,717	+ 166	..	..
Worcester	,, 12	591	— 4	,,	5,103	+ 893	..	..
Wrexham	,, 12	184	— 48	,,	1,852	— 155	..	..
Yorks. Wool. Dist.	,, 12	1,157	+ 1	,,	11,150	+ 950	..	..
Burnley	May 20	2,220	+ 234	..	..	..	..	..
Burton-on-Trent ..	,, 21	617	— 42	7	2,305	..	8¼	..
Bury	,, 14	1,960	..	6	4,121	..	..	..
†Cardiff	May 6	1,995	— 15	5	10,492	+ 23	..	..
Carlisle	,, 21	369	— 11	20	9,220	— 528	..	..
Chatham and Dist.	,, 18	1,200	+ 62	20	11,964	+ 1,306	9·3	+ ·8
Colchester	,, 17	360	..	42	8,995	..	13·75	..
Cork	,, 18	573	+ 79	20	8,626	+ 427	9·9	..
Darlington	,, 20	394	..	6	1,190	..	4·87	..
Darwen	,, 19	481	+ 55	7	1,708	+ 40	4·36	..
Dover	,, 14	394	+ 10	19	3,396	— 65	3	..
Dublin	,, 19	10,691	+ 915	..	91,835	+ 1,832	48½	+ 1½
Dundee	,, 17	1,702	+ 34	..	..	..	..	..
East Ham	,, 20	1,696	+ 232	7	5,748	+ 252	..	..
Glasgow	,, 20	31,475	+2,497	50½	732,995	+40,240	73½	+ 3
Gloucester	,, 17	607	+ 54	7	2,001	..	15	..
Halifax	,, 3	3,392	+ 643	5	7,183	+ 209	35½	+ 2½
Huddersfield ..	,, 20	2,600	+ 144	7	8,557	+ 470	..	..
Hull	,, 20	4,056	— 32	7	15,203	+ 13	13	..
†Ilford	,, 20	472	— 17	7	3,292	— 157	..	..
Ilkeston	,, 17	250	— 14	7	844	— 156	3·5	..
Ipswich	,, 20	752	— 64	7	2,900	— 200	10½	..
Isle of Thanet ..	,, 20	912	— 33	20	6,452	+ 74	..	..
Kirkcaldy	,, 17	443	+ 15	..	..	..	5½	..
Lan'kshire Trm. Co.	,, 18	1,436	+ 176	20	13,405	+ 1,184	8·6	..
Leeds	,, 20	11,411	+ 582	8	45,639	+ 1,921	89½	+ 8½
†Leicester	,, 13	2,173	..	19	35,910	..	..	..
Liverpool	,, 13	20,992	+ 949	19	192,003	+ 8,050	108	..
L.C.C.	,, 6	28,604	+7,192	5	71,016	+14,597	47½	+ 7½
Lowestoft	,, 20	282	— 27	..	..	..	..	..
Manchester	,, 20	25,052	+1,706	7	89,144	+ 3,116	..	..
Newcastle	,, 20	7,068	— 107	..	..	..	..	..
Newport	,, 20	1,145	+ 189	7	4,043	+ 687	14½	+ 1½
Oldham	,, 21	3,096	+ 837	8	13,088	+ 3,404	23½	+ 5½
Plymouth	..	..	..	..	..	..	..	..
Pontypridd	,, 20	306	..	7	1,258	..	3·75	..
Portsmouth	,, 20	3,665	+ 219	7	13,138	— 288	14½	..
†Reading	,, 11	622	+ 54	6	3,600	..	19·12	..
†Rochdale	,, 13	551	+ 442	6	3,488	+ 2,661	15·46	10·79
Salford	,, 17	8,287	+ 655	7	26,869	+ 907	30	..
Scarborough ..	,, 20	182	..	20	1,517	..	3½	..
Sheffield	,, 21	9,544	+ 341	8	38,243	+ 672	84½	+ 1½
†Southampton ..	,, 10	917	+ 14	6	5,884	— 264	16·6	..
Southend-on-Sea ..	,, 17	632	+ 72	7	2,117	+ 179	6½	..
Stockport	,, 19	1,277	+ 245	7	4 033	+ 582	11½	+ 1
Sunderland	,, 21	2,334	— 111	7	8,604	— 156	21	+ 1
Tyneside	,, 17	779	+ 100	20	7,143	+ 1,147	..	..
Warrington	,, 11	628	+ 50	6	1,940	+ 118	7½	..
West Ham	,, 18	3,252	+1,494	7	9,995	+ 4,527	10·9	+6·4
Wolverhampton ..	,, 17	1,504	+ 419	7	5,119	..	..	..
Cen. London Rly.	May 20	13,474	+ 217	20	140,386	+ 1,990	6	..
City & S. Lon. Rly.	,, 21	5,041	— 447	21	60,289	— 3,146	6½	..
Dublin-Lucan Rly.	,, 19	246	+ 4	20	2,081	+ 51	7	..
G. N. and City Rly.	,, 20	3,012	+1,208	20	31,655	..	3½	..
L'pool Overh'd Rly.	,, 21	3,073	— 226	20	31,424	— 1,882	6·67	..
Mersey Railway ..	,, 20	3,207	+ 241	20	32,078	+ 1,893	4½	..

* Compared with the corresponding period of 1904. † One week only. ‡ Includes horse and other receipts.

EXPORTS AND IMPORTS OF ELECTRICAL GOODS DURING APRIL, 1905.

The April return of electrical exports and imports shows a large diminution in both these sections. For the exports, the figures are £80,229, as compared with £114,513 in March; and the imports, with a total of £110,728, are some £20,000 less than last month.

The re-exports show a slight improvement over the same period.

A large increase, however, is apparent in the importation of electrical goods and apparatus during the first four months of the year, as compared with the corresponding period of 1904.

During the month it will be noticed that telegraph exports and imports, entered as such, are entirely absent, and that the only increases of moment are in our exports of electrically-driven machinery and in the importation of foreign cables; the decreases which are apparent elsewhere much more than compensating for these items.

India, our South African and Australian colonies, and Japan were our most valuable markets during the month.

Registered Exports of British and Irish Electrical Goods from the United Kingdom.

Country receiving exports and importing.	Electrical goods and appliances.	Electric light and power cable.	Electric lighting fittings and accessories.	Electric lamps.	Electric meters and instruments.	Electric machinery.	Batteries and accumulators.	Carbons.	Telephone material and electric bells.	Electrically-driven machinery.	Tramways apparatus and materials.
	£	£	£	£	£	£	£	£	£	£	£
Russia, Sweden, Norway and Denmark ...	1,841	...	69	264	127	199	...	...	331	345	...
Germany and German West Africa ...	5	...	...	10	59	22	7	...	...	...	...
Netherlands ...	8	...	305	35	...	89	...	...	10	...	...
Java, Dutch Borneo and Dutch Indies ...	239	...	143	38	...	30	...	...	...	...	...
Belgium ...	179	...	24	22	20	2,051	60	...	39	65	...
France, French West Africa, and Indo-China ...	495		19	10	25	69	900	...	13	...	...
Portugal, Azores, and Portuguese East Africa ...	20	51	68	...	16	103	...	...	89	...	...
Spain and Canary Isles ...	35	2	4	7	...	1,723	...	...	...	...	...
Italy ...	32	...	...	...	...	250	...	...	...	...	...
Greece ...	...	...	...	3	250	...	...	...	...	...	...
Egypt ...	213	74	...	...	...	12	3	...	...	...	...
China and Siam ...	478	357	960	249	...	827	...	46	...	...	...
Japan ...	1,294	1,450	303	112	385	802	237	...	...	...	...
U.S.A., Philippines and Cuba ...	...	...	363	59	788	119	...	...	...	...	...
Mexico, Peru and Uruguay ...	...	...	...	...	...	360	...	...	...	...	...
Chili ...	160	...	215	...	...	...	38	6	...	...	...
Brazil ...	192	...	49	76	...	86	...	3	...	...	...
Argentine ...	454	539	20	29	7	347	79	12	...	60	344
Channel Isles, Gibraltar and Malta ...	366	...	20	...	11	101	52	...	97	...	...
British West Africa ...	11	189	38	...	...	...	...	...	8	...	...
Cape of Good Hope ...	832	529	1,154	28	295	209	286	158	169	270	...
Natal ...	615	3,979	905	339	29	1,586	51	19	1,631	9,503	...
British East Africa ...	40	...	...	...	...	...	...	...	...	...	...
India ...	1,289	2,348	1,256	599	1,145	3,266	110	...	220	928	124
Burmah ...	488	..	555	42	...	3	6	...	3	282	210
Straits Settlements and Labuan ...	195	614	216	2	10	811	...	...	6	11	...
Ceylon ...	74	255	38	...	24	...	5	...	...	...	...
Hong Kong ...	19	3	219	16	...	...	...	...	11	20	...
West Australia ...	422	156	233	12	353	278	...	...	...	...	...
South Australia ...	10	..	59	...	...	141	17	...	2	23	...
Victoria ...	2,389	548	186	...	39	172	134	...	1,980	...	...
New South Wales ...	1,619	1,899	145	42	...	3,754	14	4	...	...	...
Queensland ...	...	...	...	...	...	...	...	...	43	...	...
Tasmania ...	35	...	302	...	...	...	19	...	...	...	...
New Zealand ...	92	131	530	2	72	935	88	...	578	193	...
Canada ...	32	...	17	15	4	385	...	...	...	...	...
British West Indies and British Guiana ...	145	...	16	23	...	...	2	11	33	...	...
Total, £	14,318	13,124	8,431	2,034	3,659	18,650	2,108	259	5,963	11,705	678

Registered Re-Exports of Foreign and Colonial Electrical Goods from the United Kingdom.

	£	£	£	£	£	£	£	£	£	£	£
Various countries, mainly as above. ...	1,265	167	135	193	638	3,859	...	218	1,876	...	142

Registered Imports into the United Kingdom of Electrical Goods from all Countries.

	£	£	£	£	£	£	£	£	£	£	£
Russia, Norway, Sweden and Denmark ...	37	...	..	132	8	2,403	24	...	6,843	...	...
Germany ...	4,618	9,310	2,098	101	...	5,889	69	30	1,528	...	...
Holland ...	8,290	1,631	348	...	...	1,628	30	4,903	...	...	...
Belgium ...	7,984	781	361	73	...	3,034	171	1,438	2,251	...	...
France ...	9,003	934	171	20	566	926	150	2	1,106	...	...
United States ...	4,387	192	168	1,670	274	24,578	5	294	...	127	...
Total, £	34,919	12,848	3,146	1,996	848	38,458	449	6,667	11,728	127	

Additional Imports.—Canada, electrical machinery, £112; Italy, cables, £30.

TOTAL EXPORTS: £80,229.

TOTAL RE-EXPORTS: £8,523.

TOTAL IMPORTS: £110,728.

NOTE.—The amounts appearing under the several headings are classified according to the Customs returns. The first and third columns contain many amounts relating to "goods" otherwise unclassified, the latter, doubtless, consisting of similar materials to those appearing in adjacent columns.

INSTITUTION OF ELECTRICAL ENGINEERS.

LABOUR SAVING FORMULÆ IN THE DESIGN OF DYNAMOS.

By Julius Frith, A.M.I.E.E.

(*Abstract of Paper read at Manchester, April 11th*, 1905.)

For the sake of clearness we shall take multipolar generators, with as many circuits as poles—*i.e.*, parallel, or "lap" wound—and as many commutator bars as armature convolutions,

Let D = diameter of armature in inches.
d = diameter of commutator in inches.
n = number of convolutions and commutator bars.
b = thickness of a brush in inches.
P = number of poles and armature circuits.
l = length of armature between end plates in inches.
C = current per circuit in amperes.
A = total current in amperes.
V = terminal volts.
R = revolutions per minute.

The chief constants of a generator are, after the volts, amperes and revolutions per minute. The KW. per 100 r.p.m. $= \frac{V A}{10 R}$; the armature ampere-turns per in. diameter $= \frac{C \times n}{D} = \frac{A \times n}{P \times D}$; the armature ampere-turns per pole $= \frac{C \times n}{P} = \frac{A \times n}{P^2}$; the average volts per commutator bar $= \frac{V \times P}{n}$; the peripheral speed of the commutator $= \frac{\pi d R}{12}$ feet/min.; the peripheral speed of the armature $= \frac{\pi D R}{12}$ feet/min.; and the reactance voltage of coil under commutation.

The formula for the reactance voltage is obtained from the following considerations:—

Number of convolutions under commutation at one brush

$$= \frac{\text{Thickness of brush}}{\text{Pitch of commutator bars}} = \frac{b \times n}{\pi \times d} = N.$$

In one gap there are conductors under commutation from two brushes; the magnetising force of which $= 2 N C$ ampere-turns.

If K = the lines due to 1 ampere-turn for each inch of slot parallel to the shaft, then lines set up due to commutation $= 2 N C K l = F$.

The direction of the current is changed once only ($= \frac{1}{2}$ cycle) whilst passing under one brush, hence the frequency of commutation

$$= \tfrac{1}{2} \times \frac{\text{peripheral speed of comm.}}{\text{thickness of brush}} = \frac{\pi d R}{2 \times 60 \times b} = f.$$

Volts induced in each turn $= 2 \pi f F \times 10^{-8}$, *i.e.*, reactance volts of the coil under commutation $= C . K . l . R . n \times 0{\cdot}105 \times 10^{-8}$. Now the armature reaction in ampere-turns per inch diameter $= \frac{C \times n}{D}$. Putting this value into the above equation,

Volts reactance = A. T. per 1" × R. l. D. K. × 0·105 × 10^{-8}.

Now, for a machine to stand, say, 25 per cent. overload with fixed lead, the armature ampere-turns per 1" diameter should not exceed 1,000, and the reactance voltage should not exceed 5. K, for parallel slots, can be taken = 20. From these $R \times l \times D < 240{,}000$.

N.B.—It is interesting to notice that this is really a limit to the area swept out by an active conductor per second, which

$$= R \times l \times D \times \frac{\pi}{60}, \text{ sq. in.}$$

Now by simple arithmetic the diameter of the armature

$$= \frac{\text{volts} \times \text{amperes}}{\text{ampere-turns per 1" diameter} \times \text{volts per comm. bar}}.$$

Now the volts between adjacent commutator bars should not exceed, say 10, *i.e.*, $\frac{V \times P}{n} < 10$; taking this in conjunction with armature ampere-turns per in. diameter not exceeding 1,000, $\frac{A \times n}{P \times D} < 1{,}000$, and putting in the two limiting values we have $D > \frac{KW.}{10}$. That is, if the KW. output exceeds 10 times the diameter of the armature, either the armature reaction or the volts per bar, or both, will exceed the limits given above.

Putting these two results together we get $R < \frac{2{\cdot}4 \times 10^6}{KW. \times l}$ and taking l as > 10", to be commercial, then $R < \frac{240{,}000}{KW.}$.

From this expression can be drawn up a table of speeds for various KWs, beyond which that output cannot be obtained without overstepping one or other of the following limits:—

Armature reaction, 1,000 ampere-turns per 1" diameter.
Average volts per comm. bar, 10.
Reactance voltage of coil under commutation, 5.
Length of armature between end plates, 10".

The numerical constants chosen are obviously merely arbitrary. Each designer can put in those values which he finds best accord with his own experience, without thereby altering the general conclusions arrived at.

This table would give 240 r.p.m. as the maximum speed for 1,000 KW. With these limitations the diameter for this would be

$$\frac{KW.}{10} = 100".$$

The peripheral speed of the armature = 6,300 ft. per minute. The machine would be 10" long, it would have 1,000 A.T. per inch and 10 volts per bar, and volts reactance of 5, and would probably stand 25 per cent. overload with fixed lead if the design was in all other respects as perfect as possible.

The weight of copper on the armature, at 1,500 amperes per sq. in. and 1,000 ampere-turns per in. diameter

$$= \frac{\text{diameter of armature} \times \text{length of 1 turn}}{4{\cdot}7} \text{ lb.}$$

The resistance of the armature $= \frac{D \times T}{10 A^2}$ ohms, and the $R C^2$ loss in the armature $= \frac{D \times T}{10}$ watts, where T = length of 1 turn on armature.

So far the number of poles has been in the background, the diameter for a given output and speed being quite independent of the number of poles.

The total magnetic flux of the machine, however, is dependent on the number of poles, and with our assumption of 10 volts per comm. bar, the number of convolutions on the armature $= \frac{V \times P}{10}$. So that the total flux $= \frac{3 \times 10^{10}}{P \times R}$.

To accommodate this in round magnets at 15,000 lines per sq. cm. and a waste field coefficient of 15 per cent., the diameter of magnet core $= \frac{45 \times 10^4}{P \times R}$ in.

Suppose we take 550 volts. As we have already taken 10 volts per bar, the number of comm. bars is 55 × poles.

Now in practice what limits the number of poles is

(*a*) The least permissible width of a bar, and
(*b*) The greatest permissible peripheral speed for a commutator.

Just to fix our ideas let us take 0·2" as the least *convenient* width for a comm. bar, and 3,000 ft. per minute as the greatest convenient peripheral speed for a commutator. Diameter of comm. becomes 3·5 × poles, and number of poles $= \frac{3{,}300}{\text{r.p.m.}}$.

Taking our 1,000-KW. machine at 240 r.p.m., we find that it could have 14 poles as a maximum, and diameter of comm. would equal 49"—say 50".

Also the number of turns on the armature now first appears = 55 × 14 = 770.

The diameter of round magnets would be 11·5".

Having now settled the diameter of the commutator, the next thing to settle is the length. This is ruled by considerations of heating.

The loss on the commutator results from two causes:—(*a*) The contact resistance between the brush and the commutator, and (*b*) the friction of the brush on the commutator.

The contact resistance of carbon brushes is in the neighbourhood of 0·03 ohm per sq. in., and the coefficient of friction about 0·15. Allowing 2 lb. per sq. in. pressure between the brush and the commutator, the total loss on the commutator for both these causes

$$= A \left(0{\cdot}06 \times \Delta + \frac{d \times R. \times 3{\cdot}5}{1{,}000 \times \Delta} \right) \text{ watts,}$$

where Δ = density in carbon brush in amperes per sq. in.

The product of the current and the first term in the bracket gives the $C^2 R$ loss, and the product of the current and the second term gives the friction loss, both in watts.

Next the density in the carbon brushes should be considered. As this machine is to stand 25 per cent. overload, this should not be more than about 35 amperes per sq. in.

The expression above then becomes:—

$$\text{Total loss} = A \left(2{\cdot}1 + \frac{d r}{10{,}000} \right) \text{ watts.}$$

At our assumed figure of 3,000 ft. per minute peripheral speed this expression becomes: Total loss = 3·24 × A watts.

We have now to consider the occult relation between the heat developed and the temperature rise. This can only ultimately be a matter of experience, as it depends entirely on the ventilation. For peripheral speeds of 3,000 ft. per minute, with the armature revolving at 6,000 ft. per minute near by, the figure of 15° F. rise per watt per square inch of comm. surface may be taken.

Allowing a temperature rise of 70° F. gives 4·7 watts per sq. in. And the necessary comm. surface = 3·24 A ÷ 4·7 sq. in.

As we know the diameter, the length follows $= \frac{0{\cdot}22 A}{d}$ in.

For our 1,000-KW. 550-volt generator the current = 1,800 amperes; the commutator diameter being 50", the length is 8", taking seven 1" × 1" brushes per pole.

The magnet winding is the next consideration. For the obtaining of the magnetising force required for the full load total flux, I have no short cut to offer; it must be done on the lines laid down by Dr. John Hopkinson.

The ampere-turns on each magnet pole required to compensate for the demagnetising effect of the armature are, of course, the armature ampere terms per pole × sine half the angle of the gap

(measured in electrical degrees). For a pole arc 75 per cent. of the pole pitch, this works out to $= 0{\cdot}383 \times \frac{A.\,n}{P^2}$.

If the total magnetising force required per magnet limb is $= A\,T$, and the length of the mean turn $= L$ inches, then the area for the cross-section of the wire for the shunt winding is given by the following (allowing the winding to reach a temp. of 60° C.) :—

$$\text{Area in mm.}^2 = \frac{A\,T \times L \times P}{V \times 2{,}000}.$$

Allowing 800 amperes per sq. in., with the full volts on the shunt windings at a temperature of 60° C., the convolutions per limb

$$= \frac{1{,}600 \times V}{P \times L}.$$

This gives a total length on all limbs of $45 \times V$ yd.

$$\text{Total resistance at } 15°\text{ C.} = \frac{1{,}400 \times V^2}{A\,T \times L \times P} \text{ ohms.}$$

$$\text{Total weight of copper} = \frac{A\,T \times L \times P}{2{,}500} \text{ lb.}$$

$$\text{Total magnet loss at } 60°\text{ C.} = \frac{A\,T \times L \times P}{1{,}600} \text{ watts.}$$

The winding space required, *i.e.*, the winding length on the spool × depth of winding (allowing 15 per cent. on the diameter of the wire for insulation, *e.g.*, No. 16 B.W.G., covered to 10 mils, single cotton).

$$\text{Space required} = \frac{A\,T}{480} \text{ sq. in.}$$

Allowing a depth of 3 in., winding length of spool $= \frac{A\,T}{1{,}440}$ in., which $= 0{\cdot}7$ in. per 1,000 A.T.

The sub-title of this paper would suggest turbo-generators, but the design of these falls under quite a different head from the ordinary "high-speed" steam-driven generator. The results arrived at in the present paper may, however, form a useful starting point for turbo-generator design, for it has been shown that the speed for a given KW. output is given by :—

$$R = \frac{240{,}000}{KW.} \times \frac{A\,T \text{ per 1 in. diameter}}{1{,}000} \times \frac{\text{Volts per bar}}{10} \times \frac{\text{Reactance volts}}{5} \times \frac{10 \text{ in.}}{\text{Length of arm.}} \times \frac{20}{\text{Lines per } A\,T \text{ per 1 in.}}.$$

Suppose we wish to make a 1,000-KW. generator to run at 1,500 r.p.m ; we know that if we keep the value of the constants at the figure associated with them in the above expression, then the speed can only be 240 r.p.m. If we wish the speed to be higher than this, some or all of the above constants must be sacrificed.

By the use of compensating windings and commutating poles, the armature reaction may be increased to, say, 1,200 ampere-turns per in. diameter ; both the volts per commutator bar, and the reactance volts will have to be doubled (hence the consumption of copper brushes so often referred to) ; the length of the armature parallel to the shaft will have to be increased to at least 15 in. ; the self-induction of the winding on the armature can be reduced to about half, or 10 lines per ampere-turn per in. of conductor, by the use of a smooth-core armature instead of a slotted-core.

Summing up now what we have gained, we find the new speed for 1,000 KW.—

$$R = \frac{240{,}000}{1{,}000} \times \frac{1{,}200}{1{,}000} \times \frac{20}{10} \times \frac{10}{5} \times \frac{10}{15} \times \frac{20}{10} = 1{,}536 \text{ r.p.m.}$$

so we have 36 r.p.m. in hand.

The diameter of the armature equals—

$$\frac{KW. \times 1{,}000}{A\,T \text{ per 1 in.} \times \text{volts per bar}} = 38\tfrac{1}{2} \text{ in.,}$$

making the peripheral speed 15,000 ft. per minute.

Discussion.

Mr. Wilson, referring to the author's remarks on turbo-generators, said he had never seen an armature 38 in. diameter × 15 in. long. He considered the size rather out of proportion, and thought it should be the other way about. He could not agree with the author on the question of occult relation between heat developed and temperature rise, and he would like to ask the author if he considered 15,000 ft. per minute a safe peripheral speed.

Mr. S. L. Pearce said that the Metropolitan Co. some years ago had some turbo-generators with slot-wound armatures which gave a deal of trouble. He also mentioned that they had at the Manchester (Dickinson Street) power station, turbo-generators which agreed very closely in dimensions and speed with the figures the author had given for these machines. He had, therefore, no reason to doubt the accuracy of the author's figures.

Mr. Frith, in replying, said that he did think that 15,000 ft. per minute was a safe peripheral speed for machines of the turbine class, and on the question of temperature rise, that he did not take amperes per square inch of commutator, but watts per square inch.

A hearty vote of thanks brought the proceedings to a close.

SOFTENING WATER FOR STEAM RAISING.

A useful paper on this subject was read on April 13th before the Dublin Section by Mr. L. J. Le Clair. The average loss due to the formation of scale, says the author, amounts to about 8 per cent. for each $\frac{1}{16}$-in. thickness, and the temperature of the plate on the fire side is greatly increased thereby. The author gives a diagram showing the temperature gradient with and without scale, in which, in the former case, the fall through the plate is represented as being very much steeper than in the latter; this, we may point out, is a misconception. As a matter of fact, the temperature gradient in the plate is much flatter with scale than when the plate is clean, it being obvious that heat is transmitted at a slower rate under this condition ; the great fall necessarily takes place through the scale itself, not through the plate, and the whole section of the plate is nearly at the same temperature.

Purification should be accomplished before the feed-water enters the boiler, the latter being intended for steam raising, not water softening. Patent boiler compositions should be avoided. The principal salts found in water and of interest to engineers are given in the Table subjoined.

"Temporary hardness," caused by the presence of carbonates of calcium and magnesium, held in solution as bicarbonates, can be destroyed by prolonged boiling, but this is generally more costly than chemical treatment. Clark's process, in which lime water (calcium hydrate) is added, is the best for removing temporary

Table Showing the Chief Salts Causing Temporary and Permanent Hardness, and the Treatment for their Removal.

Hardness.	Cause.	Treatment.	Reaction.
Temporary	Calcium bicarbonate $Ca(HCO_3)_2$	(1) Boiling	$Ca(HCO_3)_2 = CaCO_3 + H_2O + CO_2$ Soluble. Insol. ppt.
		(2) Adding lime water	$Ca(HCO_3)_2 + Ca(OH)_2 = 2CaCO_3 + 2H_2O$ Soluble. Sol. Insol. ppt.
	Magnesium bicarbonate $Mg(HCO_3)_2$	(1) Boiling	$Mg(HCO_3)_2 = MgCO_3 + H_2O + CO_2$ Soluble. Slightly sol.
		(2) Adding lime water	$Mg(HCO_3)_2 + Ca(OH)_2 = MgCO_3 + CaCO_3 + 2H_2O$ Soluble. Soluble. Slightly sol. Insol.
		(3) Adding further lime water	$Mg(HCO_3)_2 + 2Ca(OH)_2 = 2CaCO_3 + Mg(OH)_2 + 2H_2O$ Soluble. Sol. Insol. Insol.
Permanent	Calcium sulphate $CaSO_4$†	Adding sodium carbonate	$CaSO_4 + Na_2CO_3 = Na_2SO_4 + CaCO_3$ Sol. Sol. Sol. Insol.
	Magnesium sulphate $MgSO_4$§	Adding sodium carbonate	$MgSO_4 + Na_2CO_3 = MgCO_3 + Na_2SO_4$‡ Sol. Sol. Slightly sol. Sol.
	Magnesium chloride $MgCl_2$§	Adding sodium carbonate	$MgCl_2 + Na_2CO_3 = MgCO_3 + 2NaCl$ Sol. Sol. Slightly sol. Sol.
	Magnesium nitrate $Mg(NO_3)_2$§	Adding sodium carbonate	$Mg(NO_3)_2 + Na_2CO_3 = MgCO_3 + 2NaNO_3$ Sol. Sol. Slightly sol. Sol.

Remarks.—* $CaCO_3$ if precipitated slowly, as in economisers, forms a hard scale ; if the precipitation is rapid, as in boilers, the deposit is in the form of mud. † $CaSO_4$ forms no scale in economisers, but a hard scale in boilers. ‡ Na_2SO_4 does not decompose soap. § These three salts are liable to cause corrosion ; if it is desired to convert the slightly soluble $MgCO_3$ to the insoluble $Mg(OH)_2$, lime water may be added with the sodium carbonate, the typical reaction then being :—$MgSO_4 + Na_2CO_3 + Ca(OH)_2 = Mg(OH)_2 + CaCO_3 + Na_2SO_4$ (Sol. Sol. Sol. Insol. Insol. Sol.)

hardness, precipitating calcium carbonate and most of the magnesium carbonate; the whole of the latter can be removed by using sufficient lime water, but the result is to precipitate magnesium hydrate, a gelatinous substance which is likely to choke the filters.

The sulphates, which cause permanent hardness, are treated with sodium carbonate, precipitating calcium and magnesium carbonates, and leaving sodium sulphate in the water. The latter is removed by blowing off periodically. Sodium hydrate may also be used, but as it is formed by the reaction between sodium carbonate and lime water, these two generally suffice; moreover, sodium hydrate (caustic soda) precipitates magnesium hydrate, which is objectionable. The table on p. 869 shows the principal modes of treating water for hardness.

The quantities of reagents required to treat a water can be found from the molecular weights of the hardening salts, and the reactions given in the table. Thus 0·56 grain of lime is required to precipitate one grain of calcium carbonate, or, in other words, 0·56 grain of lime is required for each 1 deg. of temporary hardness per gallon, or 0·08 lb. for each 1 deg. per 1,000 gallons. With lime at 20s. per ton, the cost would be 0·00856d. per 1 deg. per 1,000 gallons. In the same way 0·152 lb. sodium carbonate would be required for each 1 deg. of permanent hardness, and this at £4 per ton would amount to 0·0649d. per 1 deg. per 1,000 gallons. Each degree of permanent, therefore, costs over 7½ times as much to remove as each degree of temporary hardness, or 1,000 gallons with 58 deg. temporary hardness costs for lime ½d., and 1,000 gallons with 7·7 deg. permanent hardness costs for soda, ½d.

Oil in feed water is highly detrimental, even in small quantities. It exists in the form of globules so small that they pass through filter paper with the utmost ease. The most successful method of satisfactorily eliminating oil in this condition is by means of chemicals introduced into the condensation water. These bring about a reaction which envelopes the oil particles with a precipitate, causing them to adhere together in sufficiently large groups to render filtration easy, the resulting filtrate being perfectly clear. The reagent generally used is aluminium hydrate, $Al_2(OH)_6$, readily prepared by the reaction of sodium carbonate on aluminium sulphate. The sodium carbonate and aluminium sulphate are added to the condensation water.

Another method of purification recently tried is by electrolysis, wherein the emulsified condensation water is used as an electrolyte. Electrodes are introduced into this, the current acting upon and precipitating the oil in such a form that it can afterwards be filtered out.

ELECTRIC LIFTING MACHINERY.

In a paper read at a recent meeting of the Birmingham and District Electric Club, Mr. E. C. R. Marks states that the practice of providing a separate motor for lifting, travelling and cross traversing is now adopted for all machines for heavy duty.

The most suitable form of electrical energy is continuous-current at 220 to 500 volts, as this is superior to alternating current on account of the greater starting-torque and acceleration obtained. Series-wound motors which automatically run faster with lighter loads should be used, if they are coupled permanently to the gearing, and should withstand 100 per cent. overloading for short periods. Where motors run continuously, with clutch connections to the gearing, they should be shunt-wound.

The ideal speed condition is rapid acceleration, uniform motion at high speed, and quick slowing down. Rapid acceleration can be obtained by employing series-wound motors, or by the inertia of a continuously-running shunt motor.

The use of 110 volts for small cranes is not objectionable, but the use of 500 or 600 volts, especially in foundries and steel plants where dust, moisture and metallic oxides are present, calls for constant care. Most operators have a keen respect for 500 volts, and much that would otherwise receive proper attention is left to take care of itself.

The all-important advantage of the direct current over the polyphase in the operation of crane motors, is the facility afforded for speed variation.

The motor generally employed for lift work is of the shunt wound type, with about 10 per cent. of series winding to ensure a powerful torque at starting.

In the best American practice in overhead travelling cranes there is in addition to the electro-magnetic or motor brake, what is termed the main brake or the load brake. Such load brake is of the frictional self-sustaining type, inoperative during the lifting of the load. The total resistance set up by the load between the sliding frictional surfaces of the brake is rather greater than the load itself can overcome, and thus a little work is required from a reverse running of the hoisting motor to enable the load to descend.

In the electric jib cranes, such as are used on wharves, some makers arrange to disconnect the hoisting drum from the motor and lower the load by brake, obviating the danger in a rigid connection between armature and barrel, unless care is taken in checking the speed of motor, that the momentum of the armature may cause overwinding of the chain. They claim that with a clutch connection the motor can be allowed to run on whilst the slowly moving barrel is arrested, and lowering can be commenced if desired considerably before the motor is brought to rest. For certain services such a system is doubtless advantageous. But rapidity in lifting and lowering loads of 2 to 4 tons, thus rendered possible in jib cranes for dock and like services, appears not to be possible, without some sacrifice of safety and steady working, in overhead travelling cranes and other machines for dealing with heavier loads.

Comparing electric lifts with hydraulic lifts, it is found that though the first cost of an electric lift is about 50 per cent. more than the hydraulic, the cost of current will be but 50 per cent. of the cost of water in a machine worked from a hydraulic power main. The saving thus effected will generally refund the extra first cost of the lift within four years.

At the official tests of a 3-ton Stothert & Pitt electric jib crane the efficiency of the crane at full load (*i.e.*, the ratio of the energy consumed to the work done) was found to be 73 per cent. with single reduction spur gear, new and stiff.

50-ton Adamson crane: Motor running at 400 revolutions, lifting speed 4 ft. per minute. Spur gearing. Maximum efficiency obtained 63 per cent., with load of 30 tons. With full load the efficiency was 55 per cent.

5-ton crane: Maximum efficiency—60 per cent.—obtained with 3-ton load. The efficiency of the gearing alone is given at 75 per cent., and of the motor alone 83 per cent.

70-ton crane: No tests were made at intermediate loads, but at full load the makers record an efficiency of 74½ per cent.

With regard to electric passenger lifts, Messrs. Holt & Willets with such a machine of their manufacture found that the ratio of net work done to energy supplied to the motor was 52 per cent.

As indicating the high efficiency obtainable when cut gearing is used, Mr. A. G. Hansard gives, as a result of tests on an electric winch for hauling purposes, with a speed reduction from 600 revs. per min. (speed of motor) to 24·6 revs. (speed of drums), the ratio of the respective gears being 16 to 83 and 17 to 80:—Combined efficiency 85 per cent. at ¾ load, and for full load and half load the efficiencies were 84·6 and 83·1 respectively. The efficiency of motor is given as not less than 90·5 per cent.

With good design and high class work some surprisingly good efficiencies have been obtained. With worm gear 90 per cent. has been frequently given, and in one case, recorded in the proceedings of the Institution of Civil Engineers, the figure named was 97·5 per cent., representing a coefficient of friction between the teeth as low as 0·01.

PHYSICAL SOCIETY.

At the meeting held May 12th, 1905, Dr. C. Chree, F.R.S., Vice-President, in the chair, Dr. A. D. Denning described a simple method of determining the radiation constant, suitable for a laboratory experiment.

Prof. H. L. Callendar read a paper on "A Bolometer for the Absolute Measurement of Radiation." In the practical application of the bolometric method for the absolute measurement of solar radiation, the author has introduced certain modifications suggested by experience in platinum thermometry, with the object of securing (1) Temperature compensation, so that the zero remains constant in spite of changes in the surrounding temperature; (2) Conduction compensation, so that loss of heat by conduction at the ends of the strips may not affect the readings; (3) Accurate measurement of the area of radiation absorbed.

Comparisons have been made between the bolometer, in which the platinum strips are directly exposed to radiation, and one of the author's ordinary sunshine receivers enclosed in a glass bulb, in order to determine the effect, if any, of the glass bulb in selective absorption. The values of the reduction constant obtained for the glass receiver showed no certain variation over a wide range of quality of radiation, from sunshine or arc-light down to a dull red heat. This result is probably to be attributed to a self-compensating action of the glass bulb, which radiates to the enclosed coils precisely those rays which it absorbs.

Mr. Campbell pointed out that with regard to the comparison made by Prof. Callendar between the open and the glass-covered bolometers, it should be noticed that the radiation used in the experiment had already passed through the glass of the globe surrounding the glowing filament. This would filter out some part of the radiation, possibly in such a way as to make the two instruments agree more closely than they otherwise would.

Mr. W. H. Price read a paper on the results of experiments carried out at Crompton's Works at Chelmsford, by Mr. C. H. Wright, on the possibility of using the resistance of a conductor heated by an alternating electric current as a measure of the current. An alternating current was passed through a thin conductor in series with a standard resistance, and a small direct current from a storage-battery superposed on the system. The mean differences of potential at the terminals enabled him to compare the resistances on a potentiometer. The presence of any considerable body of air near the heated conductor was found to affect the results through the irregular currents of air produced, while the neighbourhood of solid matter caused the permanent condition to be reached only slowly in consequence of its heat capacity. To obtain uniform results, so that the resistance of the conductor corresponded consistently and promptly to the current passing, it was found necessary to enclose the conductor in a relatively large vessel exhausted of air. Nearly consistent results were then obtained, affected however to some extent by the changes in the vacuum by the liberation of gas occluded in the conductor. At moderately good degrees of exhaustion the resistance of the conductor for a given current varied rapidly with the quantity of gas that remained, and it was suggested that this might form the basis of a vacuum gauge.

The results of experiments on carbon incandescent lamps, and on platinum-foil ligaments in exhausted bulbs, were shown in diagrams,

giving the effects of different air temperatures and degrees of exhaustion. The author supposed that such conductors enclosed in large glass bulbs, highly exhausted when the conductors were incandescent, would form useful gauges for electric currents. They would be perfectly portable, not easily liable to damage, capable of highly accurate and permanent calibration, and, of course, very inexpensive. They could be made of exceedingly small inductance and capacity, and their values would be independent of periodicity and wave-form. Their employment would correspond in precision and sensitiveness to other measurements of electrical resistance. The useful range of currents measured by one such conductor might be of the order of 1 to 4.

INSULATING VARNISHES.

The bulk of a current-carrying coil is largely influenced by the readiness with which heat can be dissipated from its free surface, a temperature rise of 60° or 70° C. involving such overheating of the insulation, if this is made of fibrous material, as to shorten the life of the coils. Such fibrous coverings are usually treated with a varnish having as its base a hydro-carbon or oleo-resinous substance, not only to improve their insulating qualities, but also to exclude moisture. The selection of this insulator is of great importance, efforts being directed towards finding a varnish which not only gives good dielectric strength, but also has good penetrating properties so as to percolate thoroughly into the fibrous material, and the best possible emissivity for heat. It may be noted in this connection that specially-treated varnishes for heat conduction and radiation may be obtained whose insulating properties have been impaired by such treatment.

The current number of the *American Electrician* gives particulars of investigations made by Mr. J. C. Dolph and Dr. Sharp on typical varnishes at present on the market, and, although the names of the brands are for obvious reasons suppressed, the results, taken together with the typical properties of the varnishes particularised, give a valuable starting point for independent research by electrical manufacturers in this country.

Initial experiments consisted in covering each of a number of similar tin cans with a layer of cloth painted with three coats of the varnish to be tested. Steam superheated to 10° C. was then passed through each can in turn, the amount of heat given up being deduced from the steam condensed per minute in each can. A thermopile set up at a fixed distance from the can determined the relative radiating powers, expressed in degrees of deflection on a galvanometer. An uncovered can and a can covered with soot, formed the standards of comparison. The results deduced were that varnishes specially treated for heat conduction and radiation fulfilled their function in a most marked manner as compared with ordinary varnishes, and also that a clear oleo-resinous varnish came next to these special mixtures, this being also found to have very good insulating properties.

A second series of tests consisted in winding No. 18 double-cotton-covered wire into spools approximately 6 in. long and 3 in. external diameter, the wire being first run through the varnish to be tested, and passing a current through the spools. Fine wire test coils were wound on the first (inner) layer, at the middle of the spool, and on the outside of the spool, in order to determine the temperature-gradient along the thickness of the coil by the alterations of their resistance. The spool showing the greatest gradient would be the one emitting heat most slowly. To check this method the average rise of temperature of the spool was determined by its increase in resistance. The current strength was varied, at first being insufficient to cause a temperature rise above 60° C., but in the fourth experiment carrying the temperatures up to or above the safe commercial limits. Eleven spools were wound, and treated with the following varnishes:—

No. 1 spool.—Clear, quick baking, dipping varnish of oil and gum base variety.

No. 2 spool.—Clear, baking, dipping varnish of an oil and gum base variety.

No. 3 spool.—Heat radiating varnish, brown, dipping, baking, of a combined oleo-resinous variety, specially treated for heat radiation and conduction.

No. 4 spool.—Black, dipping varnish of an oil and hydro-carbon base variety.

No. 5 spool.—Black, solid compound of bituminous variety, liquefied under heat and used only in connection with vacuum impregnation apparatus.

No. 6 spool.—Black, brushing varnish of a combined oil and hydro-carbon base, treated for heat radiation and conduction.

No. 7 spool.—Clear, baking, dipping varnish of an oleo-resinous variety.

No. 8 spool.—Black, air drying and baking, dipping varnish, of one of the hydro-carbon group.

No. 9 spool.—Black, air drying and baking, dipping varnish of a second of the hydro-carbon group.

No. 10 spool.—Untreated coil of No. 18 double cotton-covered copper wire, wound up dry.

No. 11 spool.—Gray, brushing, baking varnish of an oleo-resinous variety, treated for heat radiation and conduction.

The dry coil always retained the most heat, its external temperature in the first experiment being 56·6° C., in the second 94·2° C., in the third 137° C., and in the fourth 188° C. The following table gives the comparative temperature rises in 10 of the coils for the four ranges of current:—

—	Experiment I.	Experiment II.	Experiment III.	Experiment IV.
	Ratio.	Ratio.	Ratio.	Ratio.
1	·494	·466	·484	·465
2	·532	·545	·651	·643
3	·437	·419	·479	·456
4	·510	·506	·530	·522
6	·313	·527	·530	·530
7	·590	·520	·568	·538
8	·661	·581	·670	·663
9	·654	·685	·688	·750
10	1·000	1·000	1·000	1·000
11	·603	·653	·643	·739

Puncture tests were made on the varnishes used, which gave the following results:—

Spool No. 1	798 volts per mil.
Spool No. 2	783 "
Spool No. 3	826 "
Spool No. 4	703 "
Spool No. 5	No test made.
Spool No. 6	917 volts per mil.
Spool No. 7	811 "
Spool No. 8	765 "
Spool No. 9	890 "
Spool No. 11	83 "

The results obtained from spool No 11 amply illustrate the danger of using a varnish sold as being specially prepared for heat radiation and conduction without independent tests both for these properties and for dielectric strength.

THE BEST ECONOMY OF THE PISTON STEAM ENGINE AT THE ADVENT OF THE STEAM TURBINE.

The progress of economy of steam consumption in the reciprocating engine can best be seen by a study of the following table, compiled from a paper read by Prof. James E. Denton before the Mechanical Section of the International Congress of Arts and Sciences at St. Louis in September last:—

Performance of Reciprocating Steam Engines.

Engine reference letter	A	B	C	D	E	F	G	H
Steam pressure used	60 to 80	120	30	120	150	150	130	185
Vacuum obtained	Cir. 27	—	—	—	27·5	28·6	27·6	27·3
Revolutions per minute	—	12	—	50	—	120	126	76
Number of expansions of steam	6	16	3·5	16	26	33	32	29
Cylinder ratio	—	—	—	4 : 1	7 : 1	4 : 1	2·97 : 1	5·8 : 1
Per cent. loss by cylinder condensation	20	40	0	25	25	22	23·5	32
Per cent. loss by jacket steam consumption	—	10	—	5	8	10·7	14	0
Percentage of cylinder volume in clearances		About 4 %			Cir. 2%	4 % h.p. 7 % l.p.	4 %	10·5 h.p. 4 l.p.
Water consumption per H.P.-hour	Cir. 19	16·5	16·5	13·7	12·45	12·1	11·98	11·93

The engines referred to are the following:—

(A) The simple condensing type, formerly common in mill-practice.

(B) The Leavitt pump at Lawrence, Mass. Date 1872. Two-cylinder compound. No receiver (Wolff system). The high-pressure cylinder was in contact with the low during the whole of the latter's expansion period. Live steam jackets on both cylinders. Economy is due to high expansion ratio, high initial pressure, and re-evaporation in the cylinders.

(C) Cornish engine. Date 1840.

(D) Corliss-Pawtucket compound pumping engine with receiver between high pressure and low pressure cylinders. Date 1878. This type of compound engine supplanted the single-cylinder six-expansion engine because of its better steam consumption due to

dividing the temperature range between two cylinders. Attempts to make triple-expansion engines on the same lines showed that the steam consumption could not be brought below 12·5 lb. per H.P.-hour, which was insufficient to justify the increased cost and complication of the engine.

(E) Rockwood and Greene compound. Live steam jackets on heads or barrels of both cylinders and live steam reheating cylinder used. Without the jackets and reheater the steam consumption was 2 per cent. greater than that given in the table. Cylinder condensation was the same in both cases.

(F) 850-H.P. Rice & Sargeant compound Corliss engine. Live steam jackets on cylinder heads. Live steam reheater. The steam consumption is for a load of 600 H.P.

(G) 250-H.P. Van den Kerchove (Belgian) poppet-valve compound engine. Steam chest jackets on barrels and head. No reheater. The steam consumption is for 117-H.P. load.

(H) 5,400-H.P. Westinghouse compound twin low-pressure cylinder combined poppet valve and Corliss valve engine (for the New York Edison station). No jackets or reheaters. The steam consumption given is per indicated-horse-power-hour. Per brake-horse-power it is 12·5. The general facts as regards reciprocating engines deduced from the above figures are that the minimum steam consumption of the compound engine using saturated steam is not dependant on any particular cylinder ratio, clearance, or system of jackets, but upon the use of an expansion ratio of about 30. Above this cylinder condensation loss may outweigh gain due to expansion. This ratio will give, with any usual cylinder and clearance ratio with or without steam jacketing and reheating, a steam consumption of 12·4 lb. per H.P.-hour, with a possible variation of 0·8 lb. below or above this figure.

Comparison with the results of steam turbines is difficult, as the output of a turbo-generator is measured through a dynamo whose efficiency is not given for the range of loading employed in such tests as have been made public. A test on a 600-H.P. Westinghouse-Parsons turbine, using saturated steam at 150 lb. pressure and a vacuum of 28 in., is alone excepted, and comparative results are below given at various loads with engines F and G above, assuming that the power absorbed in friction in these engines is 3 per cent. of the indicated load plus the power shown by friction cards taken with the engine unloaded, amounting to 5 per cent. of rated power in F and 8 per cent. in G.

Per cent. of full load.	Steam (lb.) per B.H.P.-hour.		
	Turbine.	F.	G.
125	13·62	13·78	15·10
100	13·91	13·44	14·15
75	14·43	13 66	13 99
41	16 05	17·36	15 31
Average 85	14·51	14·56	14·64

The average efficiency of the three prime movers is hence practically equal.

To investigate the effect of increasing the size of turbine and engine respectively, the Elberfeld test of a Parsons turbine at full load—1,500 E.H.P.—is placed against the performance of engine H above. The turbine, with an allowance of 5 per cent. for the air-pump attached, and 95 per cent. assumed as the maximum generator efficiency, gives 13 08 lb. per B.H.P.-hour with saturated steam at 150 lb. boiler pressure and a vacuum of 28 in., 4 per cent. gain over the 600-H.P. turbine. Placing that against 12·5 lb. for 5,400 H.P. with 185 lb. steam pressure for the reciprocating type, we may again infer practical equality between the steam consumption of turbine and piston engines of large equal horse-powers.

TENDERS.

[By a Legal Contributor.]

We have often had occasion to refer to the certain points which arise in connection with contracts by tender. Persons who desire to have work done for them as cheaply as possible not infrequently advertise for tenders; safe-guarding themselves as a rule by adding a statement to the effect that they "do not undertake to accept the lowest or any tender." It may be of interest to consider some of the legal incidents which arise in connection with tenders.

In the first place, it is to be observed that although the party publishing the advertisement (whom, for the purposes of this article, we shall call "the employer") makes no statement to the effect that he cannot undertake to accept the lowest or any tender, it does not follow that he need accept the lowest or any tender, unless a trade custom to that effect be proved. In the case of Spencer *v.* Harding (L.R. 5, C P. 561), the defendants issued a circular, in which they stated that they had been instructed to offer to the wholesale trade for sale by tender the stock-in-trade of E. & Co., amounting to £2,053 13s. 1d., which would be sold at a discount in one lot. They also stated in the circular the day and the hour when the tenders would be received and opened at their offices. The plaintiffs made a tender which they alleged was the highest. In an action against the defendants for not accepting such a tender, it was decided that the circular was only an invitation for offers, and that there was no implied undertaking by the defendants to accept any invitation at all. There may, however, be a custom to the effect that the lowest (or highest, as the case may be) tender will be accepted. So in Pauling *v.* Pontifex (1 W.R. 64) the plaintiff sent to the defendants' agent a tender for the execution of certain buildings. It was held that the judge was right in concluding upon the evidence before him that, according to the custom in the trade, the plaintiff's being the lowest tender, had been accepted, although their agent had no absolute authority to accept the lowest.

Contractors who are anxious to secure a job at all costs sometimes adopt the following course. They write to the employer saying:—"We shall do the work for £200 less than the amount specified in the lowest tender received by you." The question has arisen whether such a tender is legal.

In a case tried some years ago, the question came before the Court. There a company agreed by their liquidator to accept the highest net money tender they should receive (other things being equal) from one of two rival purchasers, for the royalties accruing in respect of certain collieries. One of the parties offered £31,000, while his rival offered "such a sum as will exceed by £200 the amount to-day offered by my opponent." This was, of course, made without reference to the sum offered by the opponent. The offer of £31,000 having been accepted, the gentleman who made the second offer brought an action for specific performance on the ground that his was the highest tender. The then Master of the Rolls said:—"The plaintiff's offer was illusory. It does not answer to the description of the highest money tender either in the business or in the legal sense of the words. To hold that the plaintiff's offer answered that description would be to encourage trickery and chicanery. It would be opening the door to the grossest fraud, not only towards purchasers, but towards the vendors also." From this statement of the law it may be safely inferred that a man who offers to do a piece of work for a price lower than that demanded by any of his rivals would find his object defeated.

Tenders are generally made in writing by the persons making tenders, but there is no rule of law which insists that they shall be so made. In a case which was heard many years ago, a railway contractor met a number of persons in order to receive tenders from each of them as to the execution of certain work. The specification relating to the work was read out, and after this a number of tenders were handed in. One tender was signed by a person present, but there was no evidence that it was in his handwriting. It was held that this document, together with the specification, were sufficient to amount to a contract.

Vexed questions sometimes arise as to the time when the tender is deemed to be accepted. Thus, suppose A on January 1st, 1906, invites tenders for the installation of a certain plant; B makes a tender in which he undertakes to do the work for £1,000. Has A the right to call upon B to fulfil his tender at any time? Has B any right to withdraw his tender? In the case suggested we must regard B as a person who has made an offer.

The law provides that an offer may be retracted at any time before it is accepted. So where the defendant offered to purchase a house from the plaintiff, and to give him six weeks within which to give a definite answer, it was decided that the offer might be retracted at any time before the expiration of the period. So it is apprehended that in our suppositious case, B might at any time before acceptance withdraw his tender. What, then, is the date of acceptance? Here we come to one of those nice distinctions which are a delight to the legal mind, and a source of dismay to men of business. An offer (*i.e.*, for our own present purpose a tender)

remains open until the employer has actually received notice of its retractation; whereas the acceptance of an offer is deemed to be received as soon as it is posted. In a well-known case where the defendant wrote and posted an offer (which naturally indicates that the acceptance may be communicated in the same way) and the plaintiff wrote accepting it, and posted the acceptance, and in the meantime the defendant had written withdrawing his offer, but the letter of withdrawal had not been received by the defendant at the time of posting his acceptance, it was held that there was a complete contract. The moral of this is that if a contractor decides to withdraw his tender, he should not let the time slip by, or he may be placed in a very awkward position.

A tender and acceptance may amount to a contract, although the acceptance refers to a formal contract to be drawn up afterwards. So, where a defendant sent in a tender to do work for the plaintiff, and the plaintiff's agent replied accepting the tender, adding, "The contract will be prepared by and by," it was held that the tender and acceptance formed a complete contract.

A written contract may be essential. Thus in another case certain Poor Law Guardians, with a view to obtaining meat for the use of the workhouse, issued an advertisement, stating that they would receive tenders for the supply of the workhouse with meat for three months, from 30 to 50 stone more or less per week, describing the kind of meat; that sealed tenders were to be sent to the clerk of the guardians, *and that all contractors would have to sign a written contract after the acceptance of the tender*. The defendant wrote to the Guardians to say that he proposed to supply the workhouse with meat, according to advertisement, for the ensuing three months at 6d. per lb. This tender was accepted, and the defendant was informed that he was appointed butcher; but immediately afterwards he wrote to the Guardians to say that he declined the appointment. It was decided that as a written contract should have been executed, the acceptance of the tender did not form a binding contract, so as to render the defendant liable for refusing to supply the workhouse with meat in accordance with this tender.

When dealing with corporations, contractors will always find it prudent to have the terms of their contracts under seal. Otherwise if they rely upon mere tender and acceptance, their position may be one of some difficulty.

It might be mentioned that an acceptance in the following form:—"We accept the tender. The contract will be prepared by our solicitors" has been held to form a complete contract.

An important question sometimes arises as to the validity of an agreement amongst a number of contractors not to tender for a particular piece of work. This course is sometimes adopted in order to leave the field clear for an independent contractor, who may be under agreement to share profits with those who have stood out of the way. The principle that an agreement on these lines is not void was declared in the case of Jones *v.* North. There it appeared that tenders for the supply of stone were invited by a corporation. Four neighbouring quarry-owners entered into an agreement that they should each supply a certain proportion of the stone, and that the plaintiffs should make the lowest tender to the corporation. The plaintiffs entered into contracts with other quarry-owners to purchase the proportion of stone agreed upon from each. Notwithstanding the agreement, one of the quarry-owners sent in a tender which was accepted by the corporation. The other owners, who had been parties to the agreement, thereupon applied to the Court for an injunction to restrain the supply of stone to the corporation by the defendants. It was held, over-ruling an objection by the defendants, that the agreement was not void either as against public policy or on any other ground.

An agreement not to tender in competition appears to extend to work other than that which may be within the immediate contemplation of the parties at the time of the contract. So, in another case, A and B agreed not to tender in competition with each other for gas tar. In answer to an advertisement, and acting upon his agreement with B, A sent in a merely nominal tender, with the result that B got the contract. Later, fresh advertisements were issued, and a tender by B was rejected, whereupon A, without communicating with B, sent in a tender on his own account. It was decided that the agreement between them was still pending, and that A was liable for the breach of it.

THE REAL EFFICIENCY OF STEAM BOILERS.

By W. H. BOOTH.

In calculating the efficiency of a steam boiler the customary method is to find the ratio between the number of thermal units contained in the steam produced by the boiler and the calorific capacity of the fuel burned to produce that result.

The calorific capacity of a fuel is usually stated as the number of thermal units that it will produce when burned, and it is assumed that if there is hydrogen in the fuel the water produced by this hydrogen shall be assumed to be finally measured as water, and not as steam, at the initial temperature of the atmosphere to which the products of combustion are supposed returned. Theoretically this is correct enough—indeed, considering that the hydrogen in the coal is in solid form, whatever the chemical composition of such solid may be, it would appear to be fully as correct to base the calculation on the supposed return of the products of combustion to the state of a solid. However, assuming the ordinary practice, it seems scarcely correct that a boiler should be debited with all the thermal units produced by the hydrogen when it is impossible that the water produced shall be reduced to the liquid form. Occasionally in flue feed heaters or economisers, the water, or some of it, is condensed on the colder lower ends of the water pipes, and combining with the products of the combustion of the sulphurous parts of the fuel, produces very rapid and serious destructive corrosion of the external parts of these pipes, so that in practice good maintenance involves as a *sine quâ non* that the water shall not be asked to give up its latent heat, and it is found not to do so unless the surfaces with which it comes in contact, fall below about 100° F. The true calorific capacity of a bituminous or hydrogenous fuel ought therefore to be calculated on the basis of 52,290 B.TH.U. per lb. of hydrogen, in place of the customary 62,100 B.TH.U.

Since no boiler works below 100° F., this correction from customary methods ought properly to be made in the calorific value of a fuel, but it should be stated, of course, in any test figures, since the use of the incorrect figure is so firmly established, and the lower figure is just the sort of thing that the company promoter's expert would be likely to fasten upon to embellish his results, much as he now will sometimes innocently state the calorific capacity of fuel in B.TH.U. without troubling to mention that he means per kilogram, or *vice versâ*, if the other way round better suits the desired end.

But even the above method of stating fuel capacity is not right, and it tells against the high pressure as compared with the low-pressure boiler, which is so much cooler, and is therefore better able to absorb lower temperature heat.

It is an obvious impossibility for a steam boiler producing steam at a temperature of 290° F. to reduce the temperature of the waste gases below 290° F. It would require an infinite area of heat-absorbing surface to effect even this result, but it can at least be stated that the temperature of the boiler itself is the minimum to which furnace gases can be reduced by the boiler unaided by a lower stage of feed heating in a separate vessel. Seeing, then, that a boiler cannot absorb the heat below 290° F. in the supposititious case, is it reasonable to base the efficiency coefficient of a boiler upon the amount of heat supplied to it at any temperature? It would appear to be more correct in every way to debit the boiler with all the heat supplied to it above its own temperature, which is, of course, that of the saturated steam within it.

Thus, let it be assumed that a fuel consists of pure carbon giving 14,647 B.TH.U. per lb., what is the efficiency of a steam boiler which produces per pound of fuel, only 10 lb. of steam at 174 lb. absolute pressure from feed water fully

heated to 370° F., which is the boiler temperature? The steam contains 8,521 B.TH.U. of latent heat, and the customary efficiency of the boiler would be $\frac{8521}{14647} = 58{\cdot}1$ per cent.

The furnace products weigh, we will say, 22 lbs. per pound of fuel, and the boiler temperature is 370°, while the external atmospheric temperature is 40° F. Then the furnace gas is carrying away, or, rather, must carry away not less than 330° of temperature, and its specific heat is 0·24. Then $22 \times 0{\cdot}24 = 330 = 1{,}722$ B.TH.U. The maximum available calorific capacity of the fuel is therefore only $14{,}647 - 1{,}722 = 12{,}925$ units, and the actual efficiency of the boiler is $\frac{8521}{12925} = 66$ per cent. nearly, or 8 per cent. more than shown by ordinary methods. However large the boiler it could not possibly have absorbed more than 12,925 units. The possible performance is, in fact, only a full 88 per cent. of the fuel capacity, and as no boiler is likely to reject gases at less than 100° above its own temperature, the practical efficiencies are much less than present crude methods would indicate.

As an example, let the above number of units, 1,722, be subtracted from Shireoaks coal which has recently been stated to possess 11,886·7 B.TH.U., and to be associated with an efficiency of over 84 per cent. We have $11{,}886{\cdot}7 - 1{,}722 = 10{,}164$ as the maximum heat available. Now if 11,886·7 units show 84 per cent. efficiency, the boiler must have absorbed 9,985 B.TH.U. But $9{,}985 \div 10{,}164 =$ true efficiency of boiler = 98·2 per cent. This figure shows how very easy it would be to obtain a real efficiency of heat absorption of over 100 per cent. by making an error in the value of the fuel. It also shows how very serious may be the effect of excess of air in high-pressure boilers, for an excess of air raises the number of heat units which lie below the datum line of possible heat absorption, not to name that of practicable heat absorption. It is much to be desired that boiler efficiencies should be based on the correct available heat value of the fuel, that is, on the heat supplied above boiler temperature. It may be argued that this brings the furnace into the account. So it does, but it also serves to draw attention to the harm done by inefficient combustion and excess of air, and if furnaces and boilers are to be rated as one, it would tend to better furnace practice. Boiler efficiencies would all appear higher than they do now, but some of the present high efficiencies claimed would not bear investigation.

THE PRESENT POSITION OF THE GAS ENGINE.

By HORACE ALLEN.

The direct application of fuel in a gaseous form for the generation of power by means of the internal combustion method has so steadily advanced, more especially during recent years, that it is no longer necessary to discuss possibilities of economy or the reliability of this class of plant for continuous running and varying load requirements. However, there are a number of important details of construction, previously considered as disadvantages, which experience in this and other countries has proved to be the necessary result of circumstances and conditions not fully understood in the initial stages.

The present position of the internal combustion engine is, in my opinion, due to the satisfactory combination of (1) a water-cooled cylinder, in which (2) a piston of considerable length is fitted, having at the end nearest the combustion chamber from four to seven plain piston rings, and the remaining portion of the trunk being a close fit to the cylinder (the plain sleeve portion of the piston has considerable effect in preventing loss of compression and leakage of exploded charge when the speed has become normal. Even this type of piston, though perfectly satisfactory at the normal speed, will allow of leakage at slow speed); and (3) valves of the mushroom type fitting on coned seats. Departures from this type of engine, though sometimes necessary to suit the circumstances of the individual application, have generally involved more or less serious disadvantages and complication.

The combination outlined has been fully proved to be satisfactory for the whole range of classes of fuel gas available for power purposes, varying from natural gas of 700 B.TH.U. per cubic ft. down to the poorer class of gas having but little more than 100 B.TH U., and also vaporised benzine with its maximum initial explosive pressure of over 500 lb. per sq. in., while the practical working cylinder diameter may vary from 3 or 4 in. up to 51 or possibly more inches, in units ranging from 3 to 3,000 H.P. or more.

Another important point in regard to the range of thermal value of the fuel gas available, is that the efficiency, with any class of gas, depends more on the design of the gas engine than upon the thermal quality of the gas employed.

Numerous instances can now be quoted as to the reliability of the gas engine, and its suitability for all purposes of electricity supply. It can be applied to the running of alternators in parallel, by a modification of the design of the engine from the single cylinder Otto cycle engine to a combination of cylinders, either side by side or in tandem, one or more cylinders double-acting, or a number of vertical cylinders, coupled to a single crankshaft, the high-class manufacturer now being in a position to design a suitable type of engine to comply with all the requirements of the electrical engineer.

One especial point to be provided for is that whatever class of gas is used, it must be delivered to the engine free from tarry matter, dust, or fine fume, as otherwise provision must be made for the cleaning of the combustion chamber, valves and passages at more or less frequent intervals, according to the rate of accumulation arising from inefficiency of the gas cleansing apparatus.

From an excellent paper by Mr. Max Rotter on "Modern Large Gas Engines,"* I have condensed some of the considerations to be taken into account in selecting gas engines for central and other station work. That the gas engine is not so elastic in regard to variation in load factor as the steam engine and electric generator is now a matter of general knowledge, but this only necessitates a study of the working conditions and the provision of a unit, or units, of a rated capacity which will be capable of securing the highest economy under the special conditions of the installation in regard to normal, over and under load conditions of working; the highest economy in the gas engine being obtained at the maximum load, instead of at a load considerably below the maximum, as is the case with the steam engine, it is necessary in the gas engine to give its normal capacity as some 15 or 20 per cent. below the maximum, to allow of its coping with a higher load without causing trouble through stopping.

The first consideration to be taken into account is the maximum load which the installation may at any time be called upon to develop, then the units must be so selected as to enable the highest conditions of economy to be obtained by the fewest possible number of machines; with gas engines, when the maximum load does not exceed 50 per cent. of the average, the aggregate rated power should be equal to about 30 per cent. above the average load, coupled to generators whose aggregate rated power would be equal to the average load.

Without taking into consideration boilers and gas producers, the approximate comparative thermal efficiency of the steam and gas engines alone, based on effective power (the steam engine being compound condensing at 14½ lb. of steam per rated I.H.P. per hour, at 150 lb. pressure), is as follows:—

Generator load, 150 per cent.; steam engine load, 150 per cent.; thermal efficiency, 13 per cent.
Generator load, 150 per cent.; gas engine load, 115 per cent.; thermal efficiency, 29 per cent.
Generator load, 100 per cent.; steam engine load, 100 per cent.; thermal efficiency, 13½ per cent.
Generator load, 100 per cent.; gas engine load, 77 per cent.; thermal efficiency, 24½ per cent.
Generator load, 75 per cent.; steam engine load, 75 per cent.; thermal efficiency, 12½ per cent.
Generator load, 75 per cent.; gas engine load, 53 per cent.; thermal efficiency, 21 per cent.
Generator load, 50 per cent.; steam engine load, 50 per cent.; thermal efficiency, 10 per cent.
Generator load, 50 per cent.; gas engine load, 38 per cent.; thermal efficiency, 16 per cent.

* *Western Electrician*, U.S.A., February 25th, 1905.

As will be noted, the advantage of the gas engine over the steam engine is greatest at the maximum load of the unit, namely, about 2¼ to 1, and decreases to about 1·6 to 1 at half load.

Making due allowances for the higher efficiency of the gas producer over the boiler, losses due to condensation in the steam line over the reduction of temperature in the gas line, &c., as well as the advantage attained by feed water heaters, the efficiencies of the complete plants would be reduced to the following proportions of those of the engines alone: —

Steam plant 65 per cent.

Gas plant 70 per cent.

And the consumption of coal would be, when the generator was developing the stated percentages of its rated capacity—

150 per cent.—Coal consumption of steam plant 2¼ times that of gas.

100 per cent.—Coal consumption of steam plant 1·95 times that of gas.

75 per cent.—Coal consumption of steam plant 1⅝ times that of gas.

50 per cent.—Coal consumption of steam plant 1·2 times that of gas.

Other interesting comparisons as to capital cost, working costs, &c., are given by Mr. Rotter, but space will not permit of my including them, though if the above figures are taken as a basis when selecting a gas power unit, some of the mistakes made by consulting engineers in the past, such as putting down too small units, and so necessitating excessive floor space, will be avoided in the future.

THE CANADIAN REPORT UPON THE ELECTRO-METALLURGY OF IRON AND STEEL.

On page 1017 of our issue for December 23rd last we gave a brief abstract of the more salient features of the above report. The report itself is the outcome of instructions given by the Hon. Clifford Sifton, Canadian Minister of the Interior, to Dr. Eugene Haanel, Superintendent of Mines, in the same Department at Ottawa. Dr. Haanel was commissioned to proceed to Europe "for the purpose of investigating and reporting upon the different electro-thermic processes employed in the smelting of iron ores and the making of the different classes of steel, now in operation or in process of development, in Italy, France, and Sweden." With Dr. Haanel were associated Mr. C. E. Brown, E.E, assistant works engineer of the Canadian Electric Co., Peterborough, Ontario, as electrical engineer, a photographer and draughtsman, and a secretary; while he was instructed on arrival in England to engage the services of an iron and steel expert, who should report upon metallurgical details, and should examine the qualities of the iron and steel produced by the different electro-thermic processes studied. Mr. F. W. Harbord, A.R.S.M, F.I.C., consulting metallurgist and analytical chemist to the Indian Government, of Cooper's Hill, was selected to fill the latter post. As presented to the Government, the report is dated August 1st, 1904, and is a portly volume of 223 pages of text, accompanied by 24 photographic plates of apparatus, and 29 diagrams, many of which are scale drawings of the furnaces employed. The letterpress includes Dr. Haanel's covering report, Mr. Brown's electrical report, Mr. Harbord's metallurgical report, a special report on the Marcus Ruthenburg process for the electric smelting of magnetite drawn up by Mr. Higman, Government electrician; Mr. Locke, metallurgist; and Dr. Haanel, and signed by the latter; together with an appendix comprising two papers by M. Henri Harmet on the electro-metallurgy of iron, one on the electrical manufacture of steel by M. Gustave Gin, one on an electro-thermic process for the reduction of iron ores by Capt. Ernesto Stassano, and the report of a lecture on the treatment of copper ores by the electric furnace (Keller process) by M. Ch. Vattier—these last being translated from French or Italian.

In his general report Dr. Haanel reproduces the conclusions arrived at by Mr. Harbord, which we printed almost verbatim on the previous occasion. He adopts them without demur so far as the production of steel is concerned; but with reference to the production of pig, Dr. Haanel makes the point that the results obtained at Livet in France, on which Mr. Harbord based his opinions, were the results of experiments carried out in furnaces not specially designed for the purpose. In the improved Keller furnace, the greater height of the charge enables a better use to be made of the heat and reducing power of the gases, so that a better figure than the one obtained should result. He also observes that the modern blast furnace, and the methods of working it, are the outcome of a hundred years' experience; whilst, as a matter of fact, no plant yet exists in which pig is manufactured as a commercial operation by electrical methods. At Chats Falls, in Canada, Dr. Haanel is informed water power can be utilised which will develop 1 E H.P.-year at the rate of $4.50; and "there are probably many water-powers favourably situated as regards good bodies of ore in the provinces of Ontario and Quebec, which can be developed as cheaply." "When such power is owned by the company intending to use it for electric smelting, and peat coke or briquetted charcoal, made from mill refuse, which would probably not cost more than $4 per ton, is employed for reduction, the cost of two of the heaviest items entering into the cost of producing pig by the electric furnace is reduced to one-half." Dr. Haanel brings his report to a conclusion with the words: "When it is considered that the electric process is applicable also to the smelting of ores, such as copper, &c., and that the furnaces are of simple construction, the temperature available 1,000° C. above that of the blast furnace, and the regulation of the heat supply under perfect control, it is reasonable to expect that the near future will witness great strides in the application of electric energy to the extraction of metal from its ores, and that familiarity with handling large currents, and experience gained in electric smelting will result in solving the difficulties encountered in the smelting of ores, which up to the present time have proved refractory to all economical processes known."

Electrical Details.

Mr. Brown's report is largely taken up with details as to the type of measuring instrument employed, in checking the operation of the different furnaces in which tests were made of the reduction of ore or of the manufacture of steel from scrap. His results may, perhaps, be best summarised by reproducing two tables from the end of his report. These are given in British units, but on tons of 2,000 lb., the cost of the electrical energy being taken at $10 per horse-power-year.

Pig-Iron.

—	Héroult's process.	Keller process.	
		First run.	Second run.
Total kilowatt-hours .. .	3,280	33,700	10,840
Total horse-power-years ..	0·50	5·15	1·66
Total output of pig-iron, lb. ..	2,130	21,700	14,700
Kilowatt-hours per ton ..	3,080	3,110	1,475
Horse-power-year per ton ..	0·47	0·475	0·226
Cost of electric energy per ton	$4·70	$4·75	$2.26

Steel.

—	Kjellin's process.		Héroult's process.			Keller's process.
	Charge 516	Charge 517	Charge 658 (dead soft).	Charge 660 (tool)	Charge 660 (structural).	
Total KW.-hours ..	857	994	1,410	2,580	1,680	1,325
Total H.P.-years ..	0·131	0·152	0·216	0·395	0·257	0·203
Output of ingot, lb. ..	2,266	2,100	2,820	5,150	5,150	3,630
KW.-hours per ton ..	757	947	1,000	1,000	653	730
H P.-years per ton ..	0·116	0·145	0·153	0·153	0·10	0·112
Cost of energy per ton	$1.16	$1.45	$1.53	$1.53	$1.00	$1.12

Pig-iron.—With reference to the great discrepancies between the figures relating to the two runs in the Keller furnaces, it should be remarked that in the first case current was shut off for some time during the insertion of a recording wattmeter in the circuit. The molten iron in the crucible was thus chilled, and could not be heated again sufficiently

to cast; and M. Keller was dissatisfied with the behaviour of the furnace. Apart from this, the smaller consumption of energy in the second run must be ascribed to the conditions of operation rather than to any material difference in design or construction of the furnace. The power factor in the first run (0·737) was fairly low, and that in the second (0·564) extremely so. This is mainly due to the iron casing round each shaft of the furnace being highly magnetized, and giving a very high reactance to the circuit. If a new plant were to be erected, the casing would be omitted entirely, or, at least, between the shafts; and there seems no inherent reason why a reasonably high power factor should not be obtained by careful attention to all details in the design.

Steel.—Of the two runs with the Kjellin process included in the table, the second should be regarded as a purely experimental one; but the first represents the preparation of the standard commercial product of the furnace. The chief electrical disadvantage of the Kjellin process is the very low power factor (that for the first charge being 0·672 over the whole six hours of the run, or 0·635 for the 2 5 hours of full load current). This is due to the very high self-induction of the secondary caused by its wide separation from the primary by the interposition of the furnace wall and ventilating space, and also to its low resistance. On the other hand, the Kjellin process takes current directly at a voltage (3,000, or 5,000 to 6,000, if necessary, which is suitable for generation and transmission over moderate distances.

(To be concluded.)

NEW PATENTS APPLIED FOR.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

9,649. "Improved electric railway signalling system." P. R. J. Willis. (J. D. Gordon, United States.) May 8th.

9,652. "An improved device for automatically delivering bills of meters such as gas meters, electric meters, water meters, and the like." R. W. Gallagher. May 8th. (Complete.)

9,655. "Improvements in dynamo construction." H. Leitner and R. N. Lucas. May 8th.

9,657. "Improvements in and relating to electric accumulators." P. A. Gouin. (Date applied for under Patents Act, 1901, May 9th, 1904, being date of application in France.) May 8th. (Complete.)

9,675. "Improved electric worm reducing gear and automatic brake connected therewith." R. G. Harman. May 8th.

9,677. "A new or improved connector for electrical conductors." E. W. Hill. May 8th.

9,685. "Improvements in electrical cables." H. Edmunds and P. Dawson. May 8th.

9,702. "Improved field telephone and telegraph apparatus." P. J. Kenny. (E. Molyneux, India.) May 8th. (Complete.)

9,708. "Improved process for the electro-deposition of iron." S. Cowper-Coles. May 8th.

9,739. "Improvements in apparatus for controlling the supply of energy from alternating-current generators to alternating-current motors." A. P. Wood. May 9th.

9,746. "An attachable and detachable light reflecting and diffusing device for electric and other lamps." C. Hindle. May 9th.

9,783. "Improved construction of electric arc lamp" H. Diamant and A. Chiesa. May 9th.

9,794. "Improved apparatus for automatically regulating the potential in electric circuits." J. Kloppenstein. May 9th.

9,797. "Improvement in the method of electrically exploding the charges in the cylinders of explosion engines." H. Conduit. May 9th.

9,815. "Improvements in appliances for use in connection with the electric ignition systems for internal combustion engines." C. T. B. Sangster. May 10th.

9,837. "Improvements in apparatus for compounding synchronous alternating-current machines." Bruce Peebles & Co., Ltd., and J. L. La Cour. May 10th. (Complete.)

9,838. "Improvements in multiple unit controlling apparatus for electrically propelled trains and the like." Bruce Peebles & Co., Ltd., and J. L. La Cour. May 10th.

9,865. "Improvements in electric cables or conductors." A. Berlin. (Date applied for under Patents Act, 1901, May 10th, 1904, being date of application in Sweden.) May 10th. (Complete.)

9,884. "Improvements in main distributors for telephone exchanges." F. W. Howorth. (The Deutsche Telephonwerke R. Stock & Co., G.m.b.H., Germany.) May 10th. (Complete.)

9,887. "Improvements in and relating to the electrical driving of printing presses, calender rolls, and the like." The British Thomson-Houston Co., Ltd., and G. M. Brown. May 10th.

9,890. "Magneto electric igniter for explosion motors." L. Kootz. May 10th.

9,892. "Improvements in apparatus for regulating electric repulsion motors and similar purposes." E. Freund. May 11th.

9,908. "Improvements in connectors for electrical conductors." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) May 11th.

9,940. "Improvements in the regulation of electric circuits subject to rapidly fluctuating loads." W. Armistead and M. J. E. Tilney. May 11th.

9,949. "An improved telegraph key or 'tapper.'" J. L. Addison. May 11th.

9,966. "Improvements relating to electric group time-fuses." H. H. Lake. (The Firm Fabrik Elektrischer Zünder G.m.b.H., Germany.) May 11th. (Complete.)

9,973. "Improvements in electric controlling apparatus." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) May 11th.

9,974. "Improvements relating to oil gas, vapour, steam, compressed air and hydraulic motors for steamships, electricity works and road vehicles and general work." G. Sellers and W. Smith. May 12th.

9,991. "Improvements in electric switches." The Electric Ignition Co., Ltd., and F. H. Hall. May 12th. (Complete.)

9,993. "A safety guard for the live-rail of electric traction railways." A Swanson. May 12th.

10,016. "Improvements in electric meters." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) May 12th.

10,017. "Improvements relating to the control of electric motors." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) May 12th.

10,047. "Improvements in electric cables." W. S. Smith and W. P. Granville. May 12th. (Complete.)

10,067. "Improvements in and relating to the treatment of patients by static, galvanic or like electrical currents." G. J. Macaura. May 13th. (Complete.)

10,085. "Improvements in the ventilating arrangements of dynamo-electric generators and motors." Siemens Bros. & Co., Ltd. (Messrs. Siemens-Schukertwerke, G.m.b.H., Germany.) May 13th. (Complete.)

10,097. "Improvements in receivers for electric waves." J. C. Schafer (Date applied for under Patents Act, 1901, May 18th, 1904, being date of application in Germany.) May 13th. (Complete.)

10,100. "Improvements relating to overhead current collectors for electric railways and tramways." P. Platte. (Date applied for under Patents Act, 1901, May 14th, 1904, being date of application in Germany.) May 13th. (Complete.)

10,111. "Improvements in, and relating to, electric conductors." S. Berger. (Date applied for under Patents Act, 1901, May 14th, 1904, being date of application in Germany.) May 13th. (Complete.)

10,112. "Improved insulating base for electric switches, plugs, pushes and the like." The General Contracts Co., Ltd., and J. G. Salamon. May 13th.

10,118. "Improvements in improved system of electric train lighting. H. Leitner and R. N. Lucas. May 13th.

10,119. "Improvements in electric insulating materials." W. Kennedy-Laurie Dickson. May 13th.

10,120. "Improvements in or relating to the electro-plating of metals." J. Schiele. May 13th. (Complete.)

The Magnetic Properties of Cast-Iron.—An article has recently appeared in a German paper, in which H. Nathusius has described his researches upon the above-mentioned subject. The magnetic properties of cast-iron which are technically important are induction, permeability, hysteresis loss, remanence, and coercive force. The author's preliminary experiments with samples of cast-iron of different composition showed that the presence of manganese in the metal increases the hysteresis loss, and that, as is already known to be the case with steel and wrought-iron, increasing proportions of carbon, especially of combined carbon, have a very bad effect. There is also a relationship between the hysteresis loss and the amount of silicon in the iron Hence, in order to obtain a good magnetic cast-iron, the materials of the melt must be so arranged that the quantity of sulphur and of phosphorus shall be normal, that of manganese as small as possible, that of silicon as large as possible, that of total carbon as small as possible, and that of combined carbon reduced to the minimum. In order to avoid porosity, the metal should be blown with a powerful wind pressure, and poured very hot. The electrical resistance of cast-iron is from 0·9 to 1·9 ohm per metre and per sq. millimetre; and, therefore, it should be used for those portions of dynamos in which losses due to Foucault currents are conspicuous. The specific resistivity of cast-iron is the greater the more foreign elements are present in the metal, and the larger the proportion of it they form. The author considers that cast-iron might be employed in place of cast-steel for electro-technical purposes, on account of its higher resistivity, greater fusibility, and lower cost. In his original article he quotes numerous analyses and corresponding magnetic measurements, and with the aid of photo-micrographs discusses the influence of the different foreign substances present in the metal.—*Stahl und Eisen*, 1905, xxv, 99, 164 and 290.

The Kjellin Steel Process.—Von Engelhardt has published in *Stahl und Eisen* an examination of the Kjellin process for the electrical manufacture of steel. When cold pig is charged into the furnace, he finds the consumption of energy to be 802 and 770 kw.-hours per metric ton, but if the pig is first melted, the consumption falls to 643 kw.-hours. When ore is reduced, the operation takes 50 per cent. more time, and the energy required is about 966 kw.-hours per ton. It is believed, however, that by the use of large (736 kw.) furnaces the consumption of energy might be brought down to 590 or 490 kw.-hours per metric ton. The thermal efficiency of small furnaces is 50 or 60 per cent.; that of large furnaces over 80 per cent. when the charge is cold, and 52 per cent. when it is hot. An alternating current of 5,000 volts is employed. The loss is about 2 per cent. [of the metal?] while access of air causes 0·45 per cent. of the carbon to be wasted. At Gysinge, steel is made from pig containing up to 2 per cent. of carbon. The author calculates that in the ordinary process of making crucible steel the cost for crucibles and fuel is from 20 to 40 marks per ton, whereas the corresponding expenses in the Kjellin process are only 17·75 to 21·87 marks. He also represents the cost per ton of making steel in the basic Siemens-Martin furnace to be 75 to 80 marks, that in the acid furnace 85 to 88 marks; while in a 736-kw. Kjellin furnace taking charge of 3,740 kilos, and giving an output of 2,000 kilos, the cost per ton should be 71·42 marks if the pig is fed in cold, or 68·05 marks if it is introduced in the molten state. In the original communication many details are given respecting the management of the plant, the constitution of the charges employed, and the properties of the finished metal, the phosphorus question being also discussed at length.